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10 CFR 50.90

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Subject: Duke Energy Carolinas, LLC (Duke Energy)
McGuire Nuclear Station, Units 1 and 2
Docket Numbers 50-369 and 50-370
Technical Specifications (TS) Sections:
3.3.2, Engineered Safety Feature Actuation System (ESFAS) Instrumentation
3.5.4, Refueling Water Storage Tank (RWST)
3.6.6, Containment Spray System (CSS)

License Amendment Request for Emergency Core Cooling System (ECCS) Water Management Initiative

Reference: Letter from Dhiaa M. Jamil to NRC, ECCS Water Management Initiative, dated September 13, 2006 (ML062640514)

Pursuant to Section 50.90 of Title 10 of the Code of Federal Regulations (10CFR), Duke Energy Carolinas, LLC (Duke Energy) herein submits a license amendment request (LAR) for the Renewed Facility Operating Licenses (FOL) and Technical Specifications (TS) for McGuire Nuclear Station Units 1 and 2 to allow the manual operation of the Containment Spray System (CSS) in lieu of automatic actuation, and revise the minimum volume and low level setpoint on the Refueling Water Storage Tank (RWST). Affected sections of the TS are as follows:

1. Table 3.3.2-1 Function 2a: deleting the manual initiation function for containment spray (CS)
2. Table 3.3.2-1 Function 2b and 2c: deleting the automatic actuation logic for CS
3. Table 3.3.2-1 Function 7a: lowering the allowable value and the nominal trip setpoint for RWST Level – Low [this change also incorporates, on a limited basis, the footnotes contained in Technical Specification Task Force (TSTF) 493, Rev. 4, "Clarify Application of Setpoint Methodology for LSSS Functions" for this function only]
4. Surveillance Requirement (SR) 3.5.4.2: raising the minimum RWST volume requirement
5. SR 3.6.6.1 revised to eliminate the periodic verification of automatic spray valve position
6. SR 3.6.6.3: deleting verification of automatic CS valve actuation
7. SR 3.6.6.4: deleting the automatic CS Pump start verification
8. SR 3.6.6.5: revised to verify the capability to manually start each spray pump upon receipt of a start permissive from the Containment Pressure Control System (CPCS)

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9. SR 3.6.6.6: revised to verify the capability to manually open each spray pump discharge valve upon receipt of a start permissive from the CPCS

The Bases changes associated with this amendment request are included for information.

The objectives of this amendment request are to maximize the amount of water available for emergency core cooling from the RWST, to reduce the probability of transfer to containment sump recirculation, and to increase operator response time before the transfer to containment sump recirculation conditions are satisfied. Additionally, implementation of the proposed changes may result in a decrease in the debris loading on the ECCS containment sump strainer assemblies as recommended in NRC Bulletin 2003-01.

Following implementation of these changes, significant improvements will be gained in plant safety based on the McGuire probabilistic risk assessment. It is estimated that the implementation of this initiative will result in an approximate 22% reduction in core damage frequency. This amendment request is based on the Nuclear Energy Institute (NEI) and the Pressurized Water Reactor (PWR) Owners Group initiative to extend the post-Loss of Coolant Accident (LOCA) injection phase and delay the onset of the containment sump recirculation phase.

Duke Energy analyzed the plant response resulting from the changes proposed in this amendment request. The safety and accident analysis concluded that the plant response remained within the current design and licensing limits. Attachment 1 provides the technical and regulatory evaluations of the proposed changes.

Attachment 2 contains a marked-up version of the affected TS and Bases pages. Reprinted (clean) TS and Bases pages will be provided to the NRC prior to issuance of the approved amendment.

This amendment request contains NRC commitments as discussed in Attachment 3.

Duke Energy requests NRC approval of these proposed changes by March 1, 2011. Following NRC approval, McGuire will install the associated modifications on a staggered basis for each unit. The Unit 2 modifications are currently scheduled to be installed prior to the first entry into Mode 4 following the end-of-cycle refueling outage 20 (currently scheduled for Spring of 2011). The Unit 1 modifications are currently scheduled to be installed prior to the first entry into Mode 4 following the end-of-cycle refueling outage 21 (currently scheduled for the Fall of 2011). McGuire will implement the proposed changes by inserting the revised TS and Bases pages into the Technical Specifications subsequent to NRC approval and completion of all the modifications associated with the proposed amendment prior to the first entry into Mode 4 operations following the implementing refueling outage.

By letter dated March 24, 2010, Duke Energy submitted an LAR (ML100890320) requesting relocation of specific TS SR frequencies to a licensee controlled program consistent with TS Task Force 425, Revision 3. That LAR contained some of the same TS pages affected by this submittal. Duke Energy will track these LARs such that one does not inadvertently undo previously approved amendments. It should be noted that neither LAR relies on the approval of the other.

Implementation of the approved amendment will require changes to the McGuire Updated Final Safety Analysis Report (UFSAR). Revisions to the UFSAR will be made in accordance with 10 CFR 50.71(e).

In accordance with Duke Energy administrative procedures and the Quality Assurance Program Topical Report, this proposed amendment has been reviewed and approved by the McGuire Plant Operations Review Committee.

Pursuant to 10 CFR 50.91, a copy of this proposed amendment is being sent to the designated official of the State of North Carolina.

If you have any questions or require additional information, please contact K. L. Ashe at (704) 875-4535.

Very truly yours,

R. T. Repko

Attachments

Regis T. Repko affirms that he is the person who subscribed his name to the foregoing statement, and that all the matters and facts set forth herein are true and correct to the best of his knowledge.

Regis T. Repko

Regis T. Repko, Vice President, McGuire Nuclear Station

Subscribed and sworn to me: May 28, 2010
Date

Lori C. Dibby, Notary Public

My commission expires: July 1, 2012
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SEAL

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McGuire Master File (MG01DM)
NRIA/ELL (EC05O)

Attachment 1

LICENSE AMENDMENT REQUEST for ECCS WATER MANAGEMENT INITIATIVE
Evaluation of the Proposed Changes

1. SUMMARY DESCRIPTION

2. DETAILED DESCRIPTION

3. TECHNICAL EVALUATION

4. REGULATORY EVALUATION

   4.1 Applicable Regulatory Requirements/Criteria

   4.2 Precedent

   4.3 Significant Hazards Consideration

   4.4 Conclusions

5. ENVIRONMENTAL CONSIDERATION

6. REFERENCES

1. SUMMARY DESCRIPTION

Pursuant to Section 50.90 of Title 10 of the Code of Federal Regulations (10CFR), Duke Energy Carolinas, LLC (Duke Energy) herein submits a license amendment request (LAR) for the Renewed Facility Operating Licenses (FOL) and Technical Specifications (TS) for McGuire Nuclear Station Units 1 and 2 and associated Bases to allow manual operation of the Containment Spray System (CSS) in lieu of automatic actuation, and revise the Refueling Water Storage Tank (RWST) limits for low level (for automatic switchover to the containment sump) and minimum volume of borated water required in the RWST.

It is proposed that the McGuire TS be revised to remove the automatic start signal for the CSS. The ability to manually operate the system when the pump suction is aligned to the containment sump will be maintained. Currently, TS 3.3.2 and TS 3.6.6 require automatic CSS operation to reduce containment pressure and temperature following a high energy line break inside containment. Reanalysis of the containment response, crediting the ice condenser safety systems, has concluded that automatic CS operation is not required during the injection phase of accident mitigation and can be manually initiated later in the event once the Emergency Core Cooling System (ECCS) has been realigned to the recirculation mode of operation.

It is further proposed that the McGuire TS 3.3.2 allowable value and nominal trip setpoint for the RWST Level - Low function be lowered. This change is based on the reduced tank depletion rate following the removal of the automatic CSS operation and changes in the vortexing allowance based on testing and analytical refinements. Currently, the TS 3.3.2 setpoint is calculated based on automatic CS Pump operation with alignment to the RWST. This change also incorporates, on a limited basis, the footnotes contained in Technical Specification Task Force (TSTF)-493, Rev. 4, "Clarify Application of Setpoint Methodology for LSSS Functions" for TS Table 3.3.2-1, Function 7a only.

Duke Energy also proposes that the RWST minimum volume required by McGuire TS 3.5.4 be increased.

Benefits following approval of these TS changes include:

- Significant improvement in plant safety through reduced core damage frequency (approximately 22% reduction). The proposed changes have no significant adverse impact on the estimated large early release frequency
- Maximize available RWST inventory for ECCS coolant injection
- Reduction in the probability of sump recirculation
- Increase in allowable operator response times
- Consistency with the intent of NRC Bulletin 2003-01
- Possible reduction in containment sump debris and loading on the ECCS containment sump strainer assemblies
- Consistency with the NEI and the PWR Owners Group initiative to extend the post-LOCA injection phase and delay the onset of the containment sump recirculation phase

The following plant hardware modifications are associated with the proposed TS changes:

- Disabling the CSS automatic actuation circuitry
- Eliminate CSS actuation from the manual Phase "B"/Containment Spray pushbutton

- Adjustment of the RWST low level actuation setpoint (for automatic switchover to the containment sump)
- Adjustment of the RWST low and low-low level alarm setpoints
- Installation of new redundant wide range RWST pre-low level annunciator alarms
- Modification of the existing narrow range RWST level instrumentation to improve accuracy and support a higher TS minimum limit
- Elimination of Containment Pressure Control System (CPCS) automatic interlocks for CS Pump restart and re-opening of discharge isolation valves

In summary, following approval of the proposed TS changes, the plant response to a high energy line break is acceptable in consideration of the following:

- Containment pressure and temperature structural limits
- Component environmental qualification
- Containment sump pH
- ECCS pump NPSH
- Containment stresses at the projected sump pool temperature
- LOCA peak fuel clad temperature

The delayed actuation of containment spray proposed by this amendment request can cause sump temperature to exceed the current design temperature of 190°F. The evaluation of this increase in sump temperature determined its effect to be acceptable for piping, penetrations, containment loading and other components, with the exception that some Containment Spray System pipe supports will require requalification and modification. The requalification and modification of these pipe supports will be completed prior to utilizing the provisions of the approved amendment on the affected Unit.

Off-site and control room radiological consequences from a Loss of Coolant Accident (LOCA) were reanalyzed in support of this amendment request utilizing the Alternative Source Term (AST) methodology (current licensing basis). The results were within the limits of 10 CFR 50.67.

Duke Energy requests that the NRC approve the proposed amendment based on the improvement in plant safety.

2. DETAILED DESCRIPTION

TS currently require automatic CSS actuation following a containment pressure high-high signal. Following the actuation signal, both trains of CS Pumps start to transfer water from the RWST to the upper containment CS nozzles to reduce the containment pressure, temperature, and radioactive fission product airborne concentration.

The proposed change will remove the automatic start signal for the CSS, including the automatic starting of the CS Pump and opening of pump discharge valves. The CSS will continue to be operated manually after the Residual Heat Removal (RHR) pumps have completed the injection phase of the accident. After RHR pump suction is aligned to the containment sump, one CS Pump may be manually started if containment pressure remains greater than 3 psig and adequate sump level is verified. Specifically, the following TS requirements are requested to be deleted or modified, as applicable. (Because the associated modifications will be implemented on a staggered basis for each unit during refueling outages, the deletion or modification of these requirements is being accomplished via the use of temporary footnotes. This will allow the requirements to be either applicable or non-applicable, depending upon whether the modifications have not been implemented or implemented, respectively.)

1) Table 3.3.2-1, deleting Engineered Safety Feature Actuation System (ESFAS) Instrumentation for Function 2, Containment Spray, including:

   a. Manual Initiation

   b. Automatic Actuation Logic and Actuation Relays

   c. Containment Pressure – High-High

2) Revision of SR 3.6.6.1 eliminating the periodic verification that each automatic valve in the flow path that is not locked, sealed or otherwise secured in position is in the correct position

3) Deletion of SR 3.6.6.3 verifying each automatic CS valve in the flow path that is not locked, sealed or otherwise secured in position, actuates to the correct position on an actual or simulated actuation signal

4) Deletion of SR 3.6.6.4 verifying each CS Pump starts automatically on an actual or simulated actuation signal

5) Revision of SR 3.6.6.5 to verify the capability to manually start each spray pump upon receipt of a start permissive from the CPCS

6) Revision of SR 3.6.6.6 to verify the capability to manually open each spray pump discharge valve upon receipt of a start permissive from the CPCS

TS currently require a minimum volume of RWST inventory to be available for accident mitigation. During an accident, the initial suction source for ECCS pumps and CS Pumps is the RWST. Following a low level signal in the RWST, the suction of the RHR pumps will automatically transfer from the RWST to the containment sump. When the RWST water level reaches the low-low setpoint, operator action is required to manually realign the CS Pump suction to the containment sump. The minimum volume in the RWST and the low level setpoint are currently defined in the TS.

The proposed amendment will raise the RWST minimum volume limit and lower the low level setpoint. Specifically, the two requirements requested to be changed are as follows. (The identical methodology of employing temporary footnotes will be utilized in conjunction with these two changes.)

1) Change:

SR 3.5.4.2 Verify RWST borated water volume is ≥ 372,100 gallons.

To state:

SR 3.5.4.2 Verify RWST borated water volume is ≥ 383,146 gallons.

2) Change Table 3.3.2-1, ESFAS Instrumentation for Function 7, Automatic Switchover to Containment Sump, 7a. Refueling Water Storage Tank (RWST) Level - Low:

Allowable value ≥ 175.85 inches and nominal trip setpoint 180 inches

To state:

Allowable value ≥ 92.3 inches and nominal trip setpoint 95 inches

[Note: In conjunction with this proposed change, Duke Energy is also proposing to adopt the TS Table 3.3.2-1, Function 7a SR 3.3.2.5 and SR 3.3.2.9 (SR 3.3.2.3 and SR 3.3.2.8 in McGuire's Technical Specifications) footnotes contained in Technical Specification Task Force (TSTF)-493, Rev. 4, "Clarify Application of Setpoint Methodology for LSSS Functions" for this function only. Generic adoption of TSTF-493 for all other Functions contained in TS 3.3.1 and TS 3.3.2 is planned for a future license amendment request].

The two proposed TS changes will increase the amount of water available for ECCS injection into the Reactor Coolant System (RCS). The existing RWST narrow range level transmitters will be replaced to improve accuracy and support a higher TS minimum level. The lower RWST level setpoints are based on eliminating CS Pump post accident operation from the RWST, thereby significantly reducing the tank depletion rate. The reduction in the RWST depletion rate permits a longer response time to transfer ECCS pumps suction to the containment sump. In addition, the combination of reduced flow and utilization of a plant specific RWST vortex formation correlation reduces the penalty applied in the determination of the level setpoints.

The proposed TS 3.3.2 setpoints are calculated based on CS Pumps not depleting the available RWST volume. CS operation from the RWST will be precluded by a combination of system alignment and procedural guidance. Procedural guidance will be provided to ensure that operator action is taken to manually start one Containment Spray Pump only when aligned to the containment sump. In addition, the normal CSS alignment is such that no single failure will result in the depletion of RWST inventory by CS Pump operation. Therefore, the RWST low level setpoints may be reduced accordingly.

These changes are submitted to improve plant safety. One of the larger contributors to the overall plant risk is the sequence of plant operations to transfer ECCS suction from the RWST to the containment sump and ensure that containment sump inventory is sufficient to provide long term core cooling and containment cooling. Following implementation of this amendment, plant vulnerability to this evolution is reduced. If the conditions for transferring suction to the containment sump are met, the vulnerability associated with operating in the ECCS recirculation mode will be minimized due to (1) increased RWST inventory transferred into containment; (2) decreased flow through the ECCS containment sump strainer assemblies with single CS Pump operation; (3) elimination of the upper containment holdup volume prior to initiation of sump recirculation; and (4) possible reduced debris loading on the ECCS containment sump strainer assemblies from containment washdown due to longer debris settling times and lower velocities when relying on single train CSS operation. Additionally, operator response time is enhanced by providing additional time before reaching switchover conditions.

McGuire's license amendment request is based on the Nuclear Energy Institute (NEI) and the Pressurized Water Reactor (PWR) Owners Group initiative to extend the post-Loss of Coolant

Accident (LOCA) injection phase and to delay the onset of the containment sump recirculation phase.

Included as information in this submittal are proposed changes to TS Bases 3.3.2, 3.3.3, 3.5.4, 3.6.6 and 3.6.11 that reflect the proposed TS changes and provide clarifications, corrections and editorial revision. The proposed TS Bases changes are shown in the form of marked-up versions of the affected TS Bases pages. Following NRC approval of this amendment request, two complete versions of each corresponding TS Bases section will be utilized for ease of operator use. One version will be applicable to the existing plant configuration and one version will be applicable to the ECCS LAR modified plant configuration. McGuire will insert the revised TS and Bases pages into the Technical Specifications subsequent to NRC approval and completion of all the modifications associated with the proposed amendment prior to the first entry into Mode 4 operations following the implementing refueling outage.

3. TECHNICAL EVALUATION

Following a high energy line break, the containment pressure and temperature conditions are currently maintained within design limits by the CSS, Ice Condenser System, air return fans, and, if necessary, RHR auxiliary spray. Offsite dose is currently controlled by the containment design, containment isolation, CS, Containment Annulus Ventilation System (AVS) and RHR auxiliary spray.

Methodology to evaluate containment response following a high energy line break, described in Duke Energy Methodology Report DPC-NE-3004-PA, "Mass and Energy Release and Containment Response Methodology," has been approved by the NRC, with Safety Evaluations dated September 6, 1995 for Revision 0 and February 29, 2000 for Revision 1. Calculations of post-LOCA radiation dose using AST methodology were approved for McGuire on March 31, 2009 (Reference 1). Calculation of the RWST low level setpoint is based on current setpoint methodology.

The design basis functions for containment pressure control systems are discussed in UFSAR Section 6.2. An overview of the applicable plant systems and proposed changes follows.

3.1 Systems

3.1.1 Containment Structure

The containment is used to limit the release of radioactivity to the environment.

The primary containment vessel is a free standing steel structure that encloses the RCS. Primary containment is further divided into upper and lower compartments (also called upper and lower containment) such that any high energy line break flow within the lower containment is routed through the ice condenser before entering the upper containment.

The secondary containment is a reinforced concrete structure that surrounds the primary containment vessel. The secondary containment creates an approximate five (5) foot annulus region around the primary containment such that any primary containment leakage is filtered by the Annulus Ventilation System prior to release to the environment. Containment leakage limits are specified by TS.

During normal plant operations, TS define the primary containment pressure and upper and lower containment temperature limits such that containment conditions will remain below the design limits following a high energy line break. The containment vessel post LOCA pressure and atmosphere temperature design limits are 15.0 psig and 250°F (lower containment), 190°F (upper containment) respectively.

3.1.2 Ice Condenser

The ice condenser is used to limit containment pressure and temperature following a LOCA.

The ice condenser encompasses 300 degrees of the containment circumference. Within the ice condenser are 1944 ice baskets. There are 48 lower inlet doors separating lower containment from the ice condenser. Inlet doors are a passive design feature that will open when lower containment pressure increases following a steam leak. As steam is directed through the ice condenser, it is condensed to limit containment pressure. Condensed steam and melted ice are routed into lower containment by the ice condenser floor drains. Melted ice provides an inventory of borated water into the containment sump. Melted ice is also used to control the containment sump pH levels. Non-condensed steam will relieve into upper containment.

3.1.3 Containment Air Return (ARS) Fans

The air return fans route the air and steam within upper containment into lower containment for recirculation through the ice condenser for further reduction in containment pressure and temperature.

Two safety related fans will automatically start and associated isolation dampers open to circulate the air from upper containment into lower containment following a high-high containment pressure signal (nominally 3 psig) and an approximate 10 minute time delay. In response to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors," McGuire has the option of starting one air return fan at a containment pressure of 1 psig during certain small break LOCA (SBLOCA) transient events (Reference 2).

The proposed amendment will not result in a change to any setpoint, actuation signal, time delay or functioning of the system.

3.1.4 Containment Pressure Control System (CPCS)

The CPCS functions to prevent a vacuum condition inside containment which would cause containment design negative pressure to be exceeded. The CPCS provides permissive, inhibit, and termination signals for the CS and air return fans based on containment pressure.

Following approval of this amendment request, the CPCS automatic interlocks for CS Pump restart and re-opening of discharge isolation valves will be removed. The CS Pump will be manually started and discharge isolation valves opened from the control room.

3.1.5 Containment Spray System (CSS)

The CSS is currently credited with reducing containment pressure, temperature, and radioactivity following a LOCA after containment pressure reaches the high-high containment pressure setpoint.

The CSS consists of two trains of safety related pumps, heat exchangers, upper CS header nozzles, and associated valves and piping.

Currently, the system automatically starts following a high-high containment pressure of 3.0 psig nominal trip setpoint. Pump suction is initially aligned to the RWST and will transfer water into upper containment. Following a low-low RWST level, pump suction is manually transferred from the RWST to the containment sump.

Following approval of this amendment request, the CSS automatic start signal will be removed and spray operation will be manually controlled when pump suction is aligned to the containment sump. Credit will be taken for reducing containment pressure, temperature, and radioactivity by CS during the cold leg recirculation and hot leg recirculation phases of the accident.

The proposed changes will disable the CSS automatic actuation circuitry and eliminate CS actuation from the Phase "B"/Containment Spray pushbutton. After initiation of the ECCS recirculation phase, CS will be manually initiated and aligned to the containment sump. TS Table 3.3.2-1 will be revised to delete ESFAS Instrumentation for Function 2, Containment Spray. Following implementation of the planned modifications, this function will no longer be considered an ESFAS function.

TS SR 3.6.6.1, verification that each CS automatic valve in the flow path that is not locked, sealed or otherwise secured in position, is in the correct position, will be deleted. Following implementation of the proposed amendment, no automatic valves will be within the CSS.

TS SR 3.6.6.3 verifies that each automatic CS valve in the flow path is not locked, sealed, or otherwise secured and that they actuate to the correct position on an actual or simulated actuation signal. It is being deleted. Following implementation of the proposed amendment, the CSS will contain no automatic valve actuations. The current TS SR 3.6.6.3 Bases requires the inclusion of containment sump isolation valves NI-184B and NI-185A in TS SR 3.6.6.3. The surveillance of these containment sump isolation valves is also included in TS SR 3.5.2.5. This TS SR verifies that each ECCS automatic valve in the flow path is not locked, sealed or otherwise secured in position, and that they actuate to the correct position on an actual or simulated actuation signal. The redundant overlapping surveillance of the CS isolation valves by SR 3.6.6.3 is unneeded.

Implementation of the proposed modifications to the CSS will require the following additional changes:

- Deletion of TS SR 3.6.6.4 verifying each CS Pump starts automatically on an actual or simulated actuation signal

- TS SR 3.6.6.5 is revised to verify that each spray pump is de-energized and prevented from starting upon receipt of a terminate signal and is allowed to manually start upon receipt of a start permissive from the CPCS

- TS SR 3.6.6.6 is revised to verify that each spray pump discharge valve closes or is prevented from opening upon receipt of a terminate signal and is allowed to manually open upon receipt of a start permissive from the CPCS.

3.1.6 Refueling Canal Drains

The refueling canal drains are located at low points in the refueling canal in the Containment Building.

In the event of a design basis accident, the refueling canal drains are the main return path from upper containment to the lower containment for CSS water sprayed into the upper containment.

3.1.7 RHR Auxiliary Spray

McGuire Emergency Procedures (EPs) currently state that a portion of the RHR system flow may be aligned to a separate upper CS header as an independent method of providing additional spray flow. Auxiliary spray may be manually placed in service after RHR is aligned to the sump and a minimum of 50 minutes have elapsed after reactor trip following a LOCA.

Following approval of this amendment request, the EPs will be revised such that RHR auxiliary spray is only manually aligned upon reaching the containment vessel design pressure setpoint. For the containment response analyses provided in Section 3.2.1 of this amendment request, RHR auxiliary spray is not aligned because the containment pressure remains below the setpoint selected. The nominal setpoint selected in the analysis for aligning RHR auxiliary spray is equal to the containment design pressure.

The proposed plant EP setpoint for manually aligning RHR auxiliary spray may be decreased in the future to accommodate plant changes or provide additional peak containment pressure margin.

The containment response analyses presented in Section 3.2.1 of this amendment request demonstrate that RHR auxiliary spray is not required to obtain acceptable peak containment pressure results for the current plant configuration with the proposed changes. When instrument uncertainty is considered, operator action could be taken to align RHR auxiliary spray for design basis events. The consequences of taking action to align RHR auxiliary spray would not adversely impact either containment pressure or core cooling. While aligning RHR auxiliary spray would reduce the flow injected to the cold legs and the associated condensation rate in the RCS, the increase in the spray condensation rate in containment will more than compensate, resulting in a slightly reduced containment pressure. Secondly, should the alignment of RHR auxiliary spray occur prior to the intact loop seal refilling, this will reduce the chance of this phenomenon. Core cooling is assured for the current plant configuration by analysis that assumed RHR auxiliary spray is manually aligned at 50 minutes. Since any potential alignment of RHR auxiliary spray with the proposed changes described in this proposed amendment request will occur at a later point in time, this confirms that core cooling would be assured.

As discussed in Section 3.2.8, RHR auxiliary spray is not required to obtain acceptable post-LOCA control room and off-site doses.

The ability to align auxiliary spray will be retained for use with the functional restoration guidelines. This will maintain the RHR auxiliary spray system capability as a contingency for beyond design basis events, such as loss of both trains of normal CS.

3.1.8 Annulus Ventilation System (AVS)

During a LOCA, the AVS maintains a negative pressure within the annulus such that any primary containment leakage will flow into the annulus volume. The system reduces the concentration of airborne activity within the annulus and it filters any air discharged from the annulus to the environment.

The system consists of two redundant trains with each train consisting of a fan, filter train, and associated dampers and duct work. The system automatically starts on a containment isolation signal.

3.1.9 RWST

During accident conditions, the RWST currently provides a source of borated water to the ECCS and CS Pumps. The RWST provides water for containment cooling and depressurization, core cooling, and is a source of negative reactivity for reactor shutdown. The current and proposed TS minimum RWST volumes are presented in Table 3.1.9-1.

Table 3.1.9-1
Current and Proposed RWST Setpoints and Volumes[1]

	Current Design	Proposed Design[2]
TS Minimum	≥ 372,100 gals (456 inches indicated; 91.2 % full level)	≥ 383,146 gals (470 inches indicated; 94% full level)
(New) Pre-Low Level Alarm	N/A	121,199 gals (135 inches indicated; 27% full level)
Low Level Setpoint	156, 386 gals (180 inches indicated; 36% full level)	89,922 gals (95 inches indicated; 19% full level)
Low-Low Level Setpoint	41,442 gals (33 inches indicated; 6.6% full level)	31,277 gals (20 inches indicated; 4% full level)

Notes:
(1) Tank volumes represent "contained" volumes. Level instrument zero reference is 20 inches above RWST bottom.
(2) RWST Pre-Low Level Alarm and Low-Low Setpoint values are subject to change.

Currently, the RWST inventory between low and low-low level is used to manually realign the high and intermediate head injection pump suctions to RHR pump discharge. The CS Pumps are manually realigned to the containment sump after receipt of the RWST low–low level.

Following approval of this amendment request, only the high and intermediate head injection pumps will be supplied from the RWST below the RWST low level setpoint, thus allowing for a slower, more controlled depletion rate of the tank. Given the lower flow rates, the low-low level setpoint can be reduced from its current value, thereby increasing the usable RWST inventory.

The RWST level setpoints are established such that adequate time is provided for completion of all required manual actions to complete the switchover to cold leg recirculation prior to unacceptable RWST depletion and the potential loss of suction to the ECCS pumps.

The required manual actions are performed in two main parts, ensuring the RHR pumps have auto-swapped to the sump, and transferring the intermediate and high head safety injection pumps to RHR pump discharge. The RWST low-low level alarm setpoint is defined such that the second part of the sequence is completed before the RWST is depleted. The new redundant safety related wide range pre-low level alarm provides time before auto-swap of the RHR pump for operators to check for adequate sump level and secure RHR pump if adequate level is not available. The RWST pre-low level alarm and low-low setpoint values are subject to change based on desired margin for operator action times.

The proposed changes utilize more of the available RWST inventory and extend tank depletion time.

3.1.10 Auxiliary Building Filtered Ventilation Exhaust System (ABFVES)

The Auxiliary Building Filtered Exhaust System consists of four 50% capacity fans, two filter trains and associated ductwork. Two fans and one filter train provide filtered exhaust for each unit. The filtered exhaust takes air from potentially contaminated areas of the Auxiliary Building and filters it if a LOCA, blackout or high radiation signal occurs. Its normal function is to take air from these areas and exhaust the unfiltered air to the vent stack. These contaminated areas are maintained under a negative pressure.

The ABFVES was not initially designed as a safety related system and was not credited to mitigate a design basis accident. However, during initial plant licensing, the system was re-classified as an engineered safety feature atmosphere cleanup system and was included in Technical Specifications.

3.1.11 Control Room Area Ventilation System (CRAVS)

The CRAVS ensures that the control room will remain habitable for personnel during and following all credible accident conditions. This function is accomplished by the Outside Air Pressurization Filter trains which pressurize the control room to $\geq$ 1/8 inch water gauge with respect to the exterior with filtered outside air.

The system consists of two independent, redundant trains of equipment with each train consisting of a pressurizing filter train fan, filter unit, and associated dampers and duct work. Upon receipt of an engineered safety features signal, both trains start.

3.2 Calculations and Analysis Results

3.2.1 Containment Analysis

There are three separate parameters evaluated in the containment analyses: 1) peak containment pressure, 2) maximum sump liquid temperature, and 3) maximum containment vapor temperature. The peak containment pressure and maximum sump liquid temperature result from large break LOCA analyses. The maximum containment vapor temperature results from a large steam line break. The evaluation of each parameter is discussed below.

<u>Large Break LOCA Containment Response</u>

A reanalysis of the containment response to a large break LOCA has been performed. The containment response is determined using the Duke Energy ice condenser containment response methodology described in Methodology Report DPC-NE-3004-PA, Revision 1 (Reference 3). Revision 2 of the containment response methodology describes the changes required to perform mass and energy release calculations with the CS automatic actuation logic removed. NRC approval of Methodology Report DPC-NE-3004-P, Revision 2 was requested by the September 2, 2008 Catawba license amendment request (Reference 4). These changes are discussed further at the end of this section. This reanalysis includes the following changes:

- Increased initial RWST TS liquid inventory
- Decreased RWST low level alarm setpoint
- Decreased RWST low-low level alarm setpoint
- Elimination of the automatic CSS actuation

The reanalysis also incorporates several revisions to the EPs. These revisions are summarized below:

- Operator action to transfer high head and intermediate head safety injection pumps to take suction from RHR pump discharge is taken upon receipt of the RWST low-low level alarm
- Following transfer of the RHR pump suction to the containment sump at the RWST low level alarm, one CS Pump may be manually started after verification of adequate sump level and confirmation that containment pressure remains greater than 3 psig
- The operator does not align one RHR pump for auxiliary containment spray

The timing associated with the manual start of one CS Pump by the operators is dependent upon the single failure assumed. For most cases, the CS Pump would be aligned prior to reaching the RWST low-low level. When the single failure affects the valves that automatically swap during the RHR transfer to the containment sump, the CS Pump may be aligned after reaching the RWST low-low level.

Two criteria were examined in this reanalysis of the LOCA containment response, peak containment pressure and maximum sump liquid temperature. The results are compared against a containment design pressure of 15.0 psig and the 190°F sump temperature stated in the UFSAR. The sump temperature limit is considered applicable when ECCS is aligned to take suction from the containment sump. Each of these criteria is discussed below.

Peak Containment Pressure

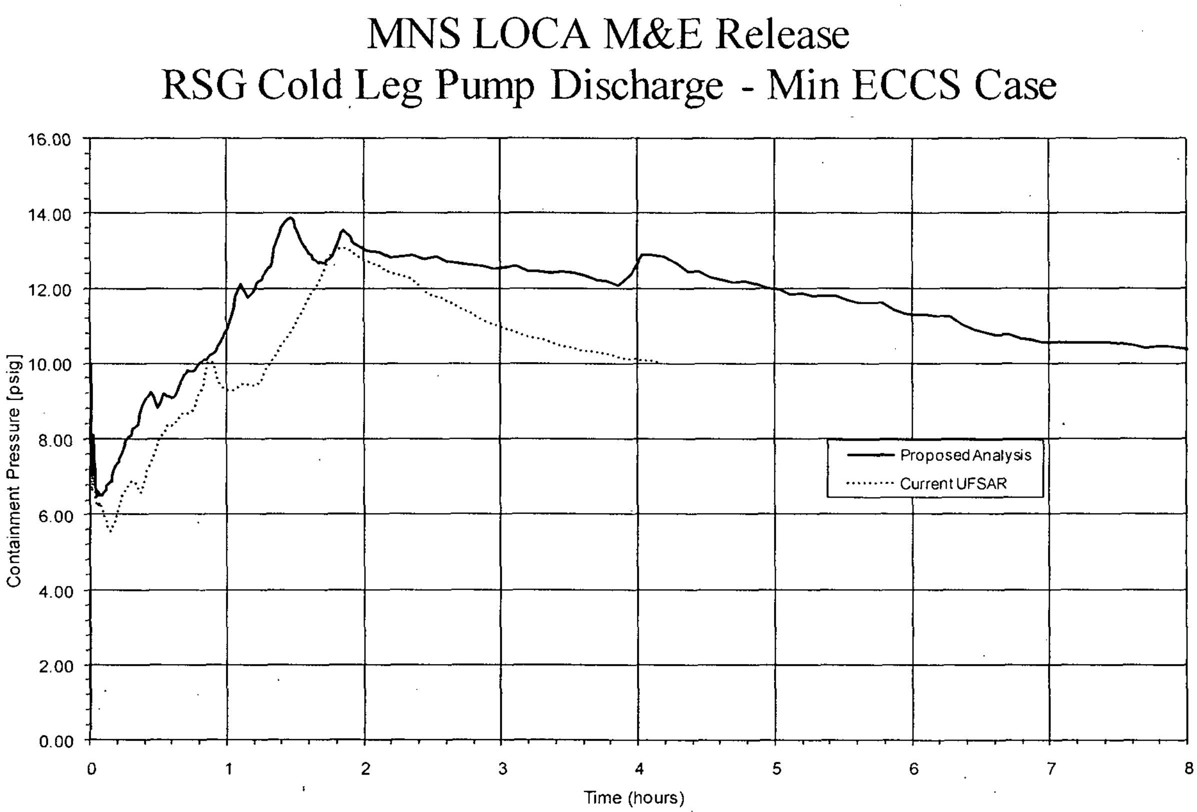
The peak containment pressure is obtained as a result of a large break LOCA located on a replacement steam generator (RSG) cold leg pump discharge pipe. This break location evolves to a boiling pot mode of core cooling, where the amount of liquid entering the core is equal to the steaming rate. The remainder of the injected ECCS spills from the broken cold leg. This provides a long term steam source that is condensed by the ice mass in the ice condenser and CS. The limiting single failure is the loss of one train of engineered safeguards. This minimizes the available CS flow and limits the number of heat exchangers available to remove heat from containment.

The peak containment pressure obtained for a cold leg pump discharge break with the changes described above is 13.87 psig, which is below the containment design pressure of 15.0 psig. This is an increase from the current peak pressure of 13.07 psig. This pressure increase is expected due to the decrease in total CS flow. In this scenario, CS is manually initiated at approximately 66.5 minutes.

Two phenomena previously not included in McGuire peak containment pressure response analyses were observed. The first phenomenon, intact loop seal refilling, directly affects the containment pressure response. The current containment analysis diverts flow from the RHR pump from the cold legs and core cooling, to be used as auxiliary containment spray. The reanalysis keeps this flow aligned to the cold legs. For a cold leg break, the core steaming rate decreases with decay heat. The majority of the steam generated in the core passes through the broken loop and is released to containment. A fraction of this steam is drawn through the intact loops by the condensation of steam by cooler ECCS injection. Eventually the steam velocity in the intact legs decreases to the point where liquid spills over the reactor coolant pump weirs and refills the intact loop seals. At this point in time, all of the steam generated in the core exits the broken loop into containment to be condensed. In Figure 3.2.1-1 shown below, this occurs just before four (4) hours.

The second phenomenon observed is a significant increase in the amount of reverse break flow. This is steam predicted to be drawn from containment into the RCS by steam condensed on subcooled ECCS injection. The Duke Energy containment response methodology is an iterative method that uses GOTHIC for the containment response calculation and RELAP5 for the mass and energy release calculation. Steam predicted to be drawn from containment into the RCS in the RELAP5 calculation is not removed from the GOTHIC calculation. This steam flow is non-conserved mass and energy. In the present containment response calculation, the predicted reverse break flow is a penalty incorporated in the results. For the reanalysis, the magnitude of this penalty is such that it was desirable to mitigate this flow. The ECCS steam condensation rate in the cold legs is mitigated by the inclusion of nitrogen in the RELAP5 containment boundary condition. This change reduced the magnitude of the reverse break flow penalty.

Figure 3.2.1-1



Maximum Sump Liquid Temperature

The maximum sump liquid temperature is obtained as a result of a large break LOCA located on a hot leg pipe. This break location allows all of the injected ECCS to flow through the core. Relative to a cold leg break, a greater fraction of the break energy is deposited in the liquid phase for a hot leg break, resulting in a higher sump liquid temperature. For this evaluation, both minimum and maximum ECCS flow is considered.

The maximum sump liquid temperature results from a hot leg break with maximum ECCS flow. At the time of switchover, sump temperature is approximately 197°F and remains above the 190°F temperature stated in the UFSAR for approximately nine (9) minutes. This result is due in part to the absence of CS flow mixing with the sump fluid. The impact of the increased maximum sump liquid temperature on NPSH is described in Section 3.2.2, and the impact on the component analysis is described in Section 3.2.3.

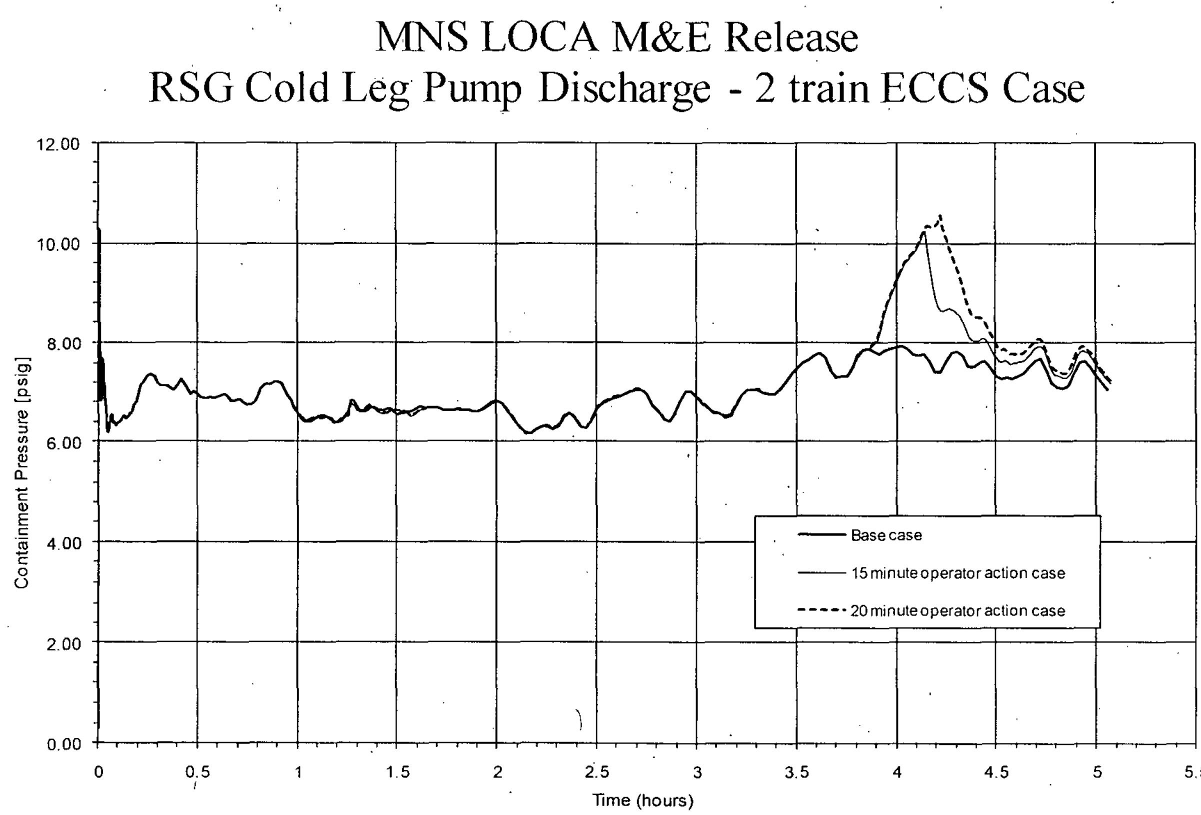
Evaluation of Containment Spray Pump EP Change

The proposed changes to the EPs include instructing the operator to start only one CS Pump from the containment sump. This is a change from the current EP strategy that starts both CS Pumps if they are available. The change creates a new potential single failure scenario, the failure of the operating CS Pump.

If the operating CS Pump were to fail upon demand, while the pump is being initially started by procedure, the operator would proceed to start the second CS Pump. This action will occur within the expected operator action time to start spray flow. Thus, this case would not be limiting from a containment pressure response perspective, as two trains of ECCS flow would be available, and more importantly, three heat exchangers would be available for rejecting heat from containment.

A sensitivity study has been performed to evaluate the containment pressure response to a CS Pump failure. The pump is assumed to fail at the time of peak pressure for the event. The results of this sensitivity study, shown on Figure 3.2.1-2, indicate that 20 minutes are available for operator action to initiate CS spray flow from the idle spray pump. If CS flow is initiated within 20 minutes, the peak containment pressure will remain below the containment design pressure. Operator action is reasonably achievable within the 20 minute timeframe.

Figure 3.2.1-2



Large Steam Line Break Containment Response

The current steam line break analysis temperature results are well below the 340°F equipment qualification (EQ) limit in lower containment. This analysis demonstrates that the average lower containment vapor temperatures peak within the first 30 seconds and return to between 250°F and 240°F by 60 seconds. The current analysis does not allow CS flow to enter lower containment. The duration of the analysis is not sufficient to include the actuation of the ARS fans. Thus, it can be concluded that the current steam line break analysis bounds the plant response with the proposed modification to remove the automatic CSS actuation logic.

The proposed modifications to the RWST will not have an impact on the peak containment vapor temperature result, as the impact of these changes is to prolong the cold leg injection phase of an event. Therefore, the proposed modifications will not impact the current peak containment vapor temperature results.

DPC-NE-3004-PA Methodology Revision 2

The Duke Energy ice condenser containment response methodology described in Methodology Report DPC-NE-3004-PA, Revision 1 (Reference 3) is used to perform the analyses described above. This version of the report does not describe the modifications to the ECCS alignments incorporated in these analyses. NRC approval of Methodology Report DPC-NE-3004-P, Revision 2 was requested by the September 2, 2008 Catawba license amendment request (Reference 4). Following NRC approval of this amendment request, Methodology Report DPC-NE-3004-PA will be revised to include the following information. The majority of this information is already described in this amendment request.

Revision 2 of the containment response methodology describes the modeling changes required to perform mass and energy release calculations with the CSS automatic actuation logic removed. These changes include:

- Removal of the CSS automatic actuation logic precludes CS flow until operator action is taken
- Operator action to align safety injection and centrifugal charging pump suction to RHR pump discharge is delayed from RWST low level until RWST low-low level
- Operator action to align RHR pump to auxiliary containment spray header is changed from 50 minutes to be based upon a containment pressure setpoint plus a delay for operator action and the RHR pumps taking suction from the sump
- Revised modeling approach that includes nitrogen to mitigate the effects of reverse break steam flow
- Description of new phenomena

3.2.2 NPSH Analysis

For the current ECCS and CS Pump available NPSH analyses, no credit was taken for elevated containment post-accident overpressure, nor for sump pool inventory static head above the nominal sump floor elevation.

The available NPSH for the ECCS and CS Pumps was reanalyzed to evaluate the proposed changes in this amendment request. The NPSH revised analyses evaluated the higher initial sump fluid temperature (reference Section 3.2.1), and resultant vapor pressure penalty. The analyses conservatively assumed that the maximum ECCS sump strainer debris laden head loss occurs concurrently with the peak sump temperature and resultant vapor pressure penalty (i.e., very early in the event). Consistent with Regulatory Guide 1.1 requirements, elevated containment post-accident overpressure was not credited; however, for the re-analysis a minimum sump pool level of three (3) feet was credited. This pool level provides for the minimum necessary sump strainer submergence. The reanalysis results demonstrated that greater than two (2) feet of water head margin was afforded for the limiting available NPSH condition (i.e., one train of CS) above that required.

The available NPSH margin continues to increase, since the sump pool peak temperature/vapor pressure exists only for a short duration.

Over the ECCS mission time, the resultant sump inventory vapor pressure decrease offsets any increase in strainer head-loss due to fluid density or debris bed effects.

3.2.3 Component Analysis

The delayed actuation of containment spray proposed by this amendment request can cause sump temperature to exceed the current design temperature of 190°F. At the time of switchover, sump temperature is approximately 197°F and remains above 190°F for about 9 minutes.

The piping and components affected by this increase in sump temperature have been evaluated at a temperature of 200°F. This evaluation was conducted in two phases.

The first phase determined that the affected portions of the suction piping of the ECCS and CS System located between and inclusive of the containment sump strainer assemblies through the Reactor Building penetrations, and the CS System piping to the pumps, heat exchangers and to the Reactor Building penetrations (i.e., piping, pumps, heat exchangers, valves and other system components, including interfacing piping), were qualified to perform their intended safety functions at or above the projected 200°F temperature.

The second phase evaluated the discharge portion of the CS System piping located in the Reactor Building annulus and steel containment vessel. The piping stress analyses for this piping was based on the original 1970s vintage CS System piping analyses. Duke Energy elected to update these analyses to analyze a faulted condition of 200°F. Those analyses determined containment loading, containment penetrations, valves and piping stresses to be acceptable.

The evaluation of CS System pipe stress analyses identified 13 pipe support restraints in the Auxiliary Building which were requalified, and 224 pipe supports in the Reactor Buildings that will be requalified due to revised loadings. Duke Energy has completed a screening to determine the potential need for modification of these pipe support restraints. This screening determined that there are approximately three (3) pipe support restraints located in the Unit 2 Reactor Building annulus and one (1) pipe support restraint located in the Unit 1 Reactor Building annulus that potentially require modification.

The requalification of the Reactor Building pipe supports and potential modification of the pipe supports in the annulus will be performed in accordance with the requirements of 10 CFR 50.59 and completed prior to utilizing the provisions of the approved amendment on the affected Unit.

3.2.4 Equipment Qualification

As a result of plant activities related to the ECCS Water Management project at McGuire Nuclear Station, the environmental accident profiles based on a LOCA accident scenario for areas located inside containment and the annulus have been revised. The Environmental Qualification (EQ) program-related electrical equipment located inside containment and the Annulus has been evaluated against the revised environmental profiles to ensure qualification is maintained under the proposed revised conditions.

The EQ equipment located within various areas of the Reactor Building at McGuire remain qualified for their respective applications, and there is no adverse impact on the existing qualifications with the proposed revised environmental conditions for ECCS Water Management activities.

The computer code CANVENT was used to determine the effect of the proposed modifications on post-accident annulus air temperature. Only post-LOCA temperatures in the annulus were calculated. The current steam line break containment analysis was found to bound the plant response with the proposed modifications (see discussion in Section 3.2.1 "Large Steam Line Break Containment Response" for further details). For this reason, the post-steam line break annulus temperature was not calculated for the proposed modifications.

The model of the Annulus Ventilation System employed in the radiological effluent analysis (described in Section 3.2.8) was also used for equipment qualification with three differences.

(1) The initial annulus conditions were calculated based on a high outside air temperature which bounds the 99th percentile in the Charlotte, North Carolina area. This is conservative compared to current NRC guidance for modeling dual containments in an analysis of post-LOCA radiological consequences (Reference 5, Section A.4.3).

(2) The post-LOCA containment conditions were based on an ultimate heat sink scenario that conservatively maximized post-LOCA temperatures.

(3) The Reactor Building was conservatively assumed not to leak.

The maximum post-LOCA annulus air temperature was found to be 155°F.

3.2.5 RWST Minimum Volume Calculation

The existing narrow range RWST level transmitters will be replaced to reduce the overall instrument loop measurement uncertainty, and allow a higher Technical Specification minimum RWST volume to be maintained. The RWST TS SR 3.5.4.2 minimum volume level will be increased from 372,100 gallons (456 inches) to 383,146 gallons (470 inches) resulting in a usable volume increase of 11,046 gallons).

The narrow range RWST instrument loops are used to verify the pre-accident initial conditions of the RWST volume in accordance with TS SR 3.5.4.2. This surveillance ensures the minimum volume of borated water is available by the ECCS and CS for accident mitigation. These instruments are only used for the surveillance and do not actuate automatic or manual operator actions for accident mitigation.

3.2.6 RWST Low Level Allowable Value and Setpoint Analysis

Upon reaching the RWST low level setpoint, the suction source for the RHR pumps will automatically transfer to the containment sump. The high head and intermediate head safety injection pumps are transferred to the containment sump by manual operator action once the RWST low-low level setpoint is reached. The RWST low and low-low level setpoints are calculated such that the RHR pumps and the high head and intermediate head safety injection pumps will be aligned to the containment sump prior to reaching the RWST level at which vortexing is predicted to occur.

The RWST low level setpoint provides a volume allowance above the predicted vortex level to account for the maximum RWST outflow during switchover with the most limiting single failure, plus an allowance for instrument error. The most restrictive single failure is the failure of one of the RWST-to-RHR suction isolation valves to close, thus maximizing RWST outflow during switchover. To mitigate this failure, manual operator action is required to close a second valve in series.

Removal of the automatic start of the CS Pumps reduces the outflow from the RWST during switchover. This reduction in the RWST depletion rate permits a longer response time to transfer the ECCS pump suction to the containment sump, and also decreases the RWST level needed to preclude air entrainment due to vortexing. Therefore, the RWST low level setpoint may be reduced to 95 inches with an allowable value of 92.3 inches.

The current allowable low level setpoint of 175.85 inches allows sufficient time for the operator to stop all ECCS pumps prior to reaching the predicted RWST vortex level, satisfying this requirement. Since the proposed modifications will reduce the RWST depletion rate, the available operator response time will be increased.

<u>Setpoint Calculation Changes</u>

Introduction

Setpoint calculation revisions were performed in support of the planned plant modifications, resulting in the need for changes to associated values listed in TS Table 3.3.3.2-1, "Engineering Safety Feature Actuation System Instrumentation," as described in Section 2.0 above. These setpoint calculations were performed in accordance with Duke Energy Engineering Directives Manual (EDM)-102, "Instrument Setpoint/Uncertainty Calculations." The methodology described in EDM-102 is consistent with the intent of Instrument Society of America (ISA) Standard RP67.04-1994 Part II, "Methodologies for the Determination of Setpoints for Nuclear Safety Related Instrumentation."

Basic Methodology – EDM-102

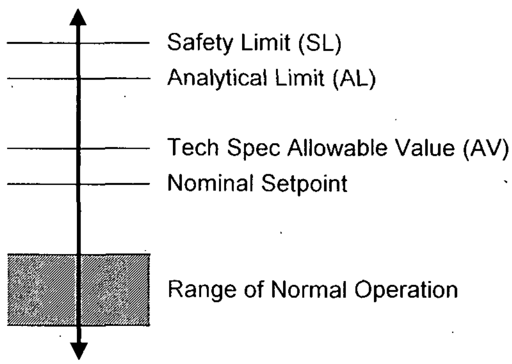
The loop uncertainty methodology is primarily based on the "Square-Root-Sum-of-the-Squares" (SRSS) technique for combination of random-independent uncertainty terms. Random-dependent and bias uncertainty terms must be addressed through a combination of the SRSS and/or algebraic techniques.

The overall methodology requires identification of applicable sources of instrument uncertainty, and categorization of each as a random-independent (x,y), random-dependent (w,u), and bias/abnormal distribution (v,t) terms. The magnitude of each term is then combined to determine the "Total Loop Uncertainty" (TLU) as depicted below. The "+" and "-" convention represents the positive or negative uncertainty limits within the measured setpoint or indication.

$$+\text{TLU}=+\{x^2 + y^2 + (w + u)^2\}^{1/2} + v + t$$
$$-\text{TLU}=-\{x^2 + y^2 + (w + u)^2\}^{1/2} - v - t$$

The treatment of bias/abnormal distribution terms requires additional discussion. Bias terms are typically based on conservative estimates and are predictable. Bias terms would normally be applied only in an additive manner, to the respective "+" or "-" TLU component. Biases of unknown direction would be applied in an additive manner to both the -TLU and +TLU determinations. Application of a non-reoccurring bias term shall not be applied so as to decrease a TLU value. Proper application of a bias would normally result in reduced margin for the setpoint limit of interest. Terms that have an abnormal distribution cannot be SRSS'd with normally distributed terms and must therefore be added as a limit of error in both directions.

Evaluation of setpoint acceptability requires comparison of the total loop uncertainty against the operational ranges and the protected limits (process, analytical, and/or safety limits). This setpoint relationship is based on guidance in Regulatory Guide (RG) 1.105, "Instrument Setpoints for Safety-Related Systems." The typical reactor protection and/or safeguard setpoint relationship, depicting a high process setpoint, is depicted as follows:



Safety Limits (SL) are the values chosen to reasonably protect the integrity of physical barriers that guard against the uncontrolled release of radioactivity.

Analytical Limits (AL) typically are values utilized in the safety analyses, which were specifically chosen to allow the equipment time to act and prevent exceeding the Safety Limits.

The Allowable Value (AV) represents an acceptable benchmark (specified by Technical Specifications) for which periodic calibrations/checks must fall within to ensure operability. When a channel "as-found" condition is determined to be less conservative than the AV, the channel must be declared inoperable. The AV determination is based on expected uncertainty influences for the portion of the loop tested. Uncertainty magnitudes must be representative of the surveillance interval duration. Examples of typical uncertainty influences, which may be measured during testing, are reference accuracy, calibration uncertainty, representative uncertainty for temperature variations between calibrations, representative drift over surveillance interval, etc. The AV determination shall be based on the most conservative of either EDM Method 1 or 2, outlined below. EDM Method 2 is typically more conservative for applications with little or no margin from the AL. Conversely, EDM Method 1 is more conservative for applications with substantial margin. The combination of terms for the AV determination should be consistent with that for the TLU value.

$$TLU = +/- [RU_{NT}^2 + RU_T^2]^{1/2} + \text{biases}$$

where:

- NT = denotes uncertainty associated with the portion of the loop not tested during the channel check, calibration, etc.
- T = denotes uncertainty associated with the portion of the loop tested during the channel check, calibration, etc.
- RU = total random uncertainty

<u>*EDM METHOD 1*</u>

$$AV = SP +/- RU_{T-cal}$$

where: SP = nominal setpoint
+/- = "+" or "-" sign convention dictated by whichever is in the direction of the Analytical Limit (i.e. towards AL)
T-cal = includes representative (minimum) uncertainty term magnitudes associated with the portion of the loop tested and for the desired interval (attributed to the expected variation from "as-left" conditions).

<u>*EDM METHOD 2*</u>

$$AV = AL +/- RU_{NT} = AL +/- \{[(TLU - Biases)^2 - RU_{T-cal}{}^2]^{1/2} + Biases\}$$

where: AL = Analytical Limit
+ / - = "+" or "-" sign convention dictated by whichever is in the direction setpoint (i.e. towards setpoint)

Total Loop Uncertainty

The setpoint calculation revisions used the EDM-102 methodology to determine the channel uncertainty. Applicable device uncertainties were determined and then combined for random-independent terms. Applicable biases were then added.

The calculated TLU value is as follows:

Instrument	TLU	Percent Full Level
RWST Low Level	≤ ± 10 inches	≤ ± 2%

Analytical Limits

The Analytical Limit (AL) is the limit of a measured or calculated variable established by the safety analyses to ensure that a safety limit is not exceeded.

The purpose of the RWST low level setpoint is to automatically begin the switchover of the Residual Heat Removal Pumps (RHR) to the containment sump in conjunction with a safety injection signal and to alert the operator that the necessary manual actions for completing the transfer to cold leg recirculation must be started. The low level setpoint is established such that all necessary steps are performed prior to the receipt of the RWST low-low level alarm.

Instrument	Value	Percent Full Level
RWST Low Level	76.9 inches	15.38%

Nominal Trip Setpoint

The Nominal Trip Setpoint (NTSP) is the value at which the trip or actuation is intended to occur. The NTSP is primarily chosen to assure that a trip or safety actuation occurs before the process reaches the AL. Secondarily, the NTSP is chosen to assure the plant can operate and experience expected operational transients without unnecessary trips or safeguards actuations. Many methods are available to determine a NTSP which prevents a process from exceeding the AL while providing adequate operating margin. The following equation represents one such acceptable method for determining the Nominal Trip Setpoint:

$$NTSP = AL \pm (TLU + Margin)$$

Note that the margin term is an allowance added to the instrument channel uncertainty which moves the setpoint farther away from the AL. The TLU plus margin allowance is summed or subtracted from the AL depending on whether the process is increasing or decreasing toward the NTSP.

The calculated Nominal Trip Setpoint is as follows:

Instrument	Nominal Trip Setpoint	Percent Full Level
RWST Low Level	95 inches	19%

Allowable Values

The Allowable Value is a limiting value that the trip setpoint may have when tested periodically, beyond which the channel must be declared inoperable. The AV for each setpoint is calculated using the two EDM methods described above in the section entitled "Basic Methodology - EDM-102." The more conservative calculated value for the two methods is then utilized as the AV.

The calculated Allowable Value is as follows:

Instrument	Allowable Value	Percent Full Level
RWST Low Level	92.3 inches	18.45%

As-Found Tolerance

"As-found" is the condition in which a channel, or portion of a channel, is found after a period of operation and before recalibration (if necessary). The As-Found Tolerance is the allowance within the TLU that the channel or portion thereof must be within to ensure the channel is capable of producing a trip prior to reaching the Safety Analysis AL. Values recorded during a channel as-found surveillance which are less than the As-Found Tolerance would clearly indicate a channel is operating as intended. Values recorded during a channel as-found surveillance which exceed the As-Found Tolerance would require a more detailed review to determine the effects of the increased uncertainty on the operability of the channel. Uncertainties which make up the As-Found Tolerance for the portion of the channel under surveillance include, reference accuracy, drift, and measurement and test equipment.

The calculated As-Found Tolerance for the RWST Level channels is as follows:

Instrument	As-Found Tolerance	Percent Full Level
RWST Low Level	± 1.67 inch	± 0.33%

As-Left Tolerance

"As-left" is the condition in which a channel, or portion of a channel, is left after calibration or final setpoint device setpoint verification. The As-Left Tolerance is the acceptable setting variation about the setpoint that the technician may leave the setting following calibration. The size of the setting or As-Left Tolerance is generally based on the reference accuracy and limitations of the technician in adjusting the module (measurement and test equipment and reading resolution). The previous calibration or surveillance as-left setting value for a channel shall be used as the starting point for determining if the next surveillance As-Found Tolerance is met.

The calculated As-Left Tolerance for the RWST Level channels is as follows:

Instrument	As-Left Tolerance	Percent Full Level
RWST Low Level	± 0.5 inch	± 0.1%

Summary

The proposed change to the allowable value and the nominal trip setpoint for the RWST low level have been addressed and found acceptable in calculations and analysis.

<u>Changes Related to TSTF-493</u>

Included in the scope of the proposed changes is the addition of two new lettered footnotes applicable to the affected Surveillance Requirements listed in TS Table 3.3.2-1, Function 7a for a RWST low level coincident with safety injection. These footnotes are consistent with TSTF Traveler TSTF-493, "Clarify Application of Setpoint Methodology for LSSS Functions," Revision 4. These footnotes are only applied to the RWST low level coincident with safety injection consistent with the definition of Safety Limit Limiting Safety System Setting (SL-LSSS) as described in TSTF-493, Revision 4. No other SL-LSSS is impacted by this license amendment request.

The first proposed lettered footnote requires evaluation of channel performance for a condition where the as-found setting for the channel setpoint is outside its As-Found Tolerance but is conservative with respect to the Allowed Value. Evaluation of channel performance will verify that the channel will continue to behave in accordance with safety analysis assumptions and the channel performance assumptions in the setpoint methodology. The purpose of the assessment is to ensure confidence in channel performance prior to returning the channel to service.

The second proposed lettered footnote requires that the as-left setting for the channel be returned to within the As-Left Tolerance of the Nominal Trip Setpoint (NTSP). Where a setpoint more conservative than the NTSP is used in the surveillance procedures (field settings), the as-left and As-Found Tolerances, as applicable, will be applied to the surveillance procedure setpoint. This will ensure that sufficient margin to the Safety Limit and/or the Analytical Limit is maintained. If the as-left channel setting cannot be returned to a setting within the As-Left Tolerance of the NTSP, then the channel is declared inoperable. Additionally, this footnote requires that the methodologies for calculating the as-left and As-Found Tolerances be in the UFSAR.

These proposed new footnotes enhance safety by ensuring that unexpected as-found conditions are evaluated prior to returning the channel to service and ensuring that as-left settings provide sufficient margin for uncertainties.

3.2.7 Containment Sump pH

The current licensing basis (CLB) post-LOCA containment sump pH model (Reference 1) was modified to reflect the implementation of the modifications associated with the proposed amendment. The CLB model was used as the starting point to ensure the use of the current licensing basis sump pH methodology in the analysis of the proposed amendment. Thus, the differences between these two cases are restricted to their inputs, as the model was updated to reflect only changes to input parameters affected by the implementation of the proposed amendment.

Plant response to the LOCA, will continue to use the RWST as the initial suction source for the RHR System, the Safety Injection (SI) System, and the Chemical and Volume Control System (CVCS). The CSS has been removed as a RWST suction source. In the sump pH model, once the RWST level drops to the low level setpoint, the RHR pumps are removed from service. When the RWST reaches the low-low level setpoint, no further draw down of the tank is modeled.

The CLB post-LOCA sump pH profile was provided in Reference 6. The proposed amendment post-LOCA sump pH profile is shown in Figure 3.2.7-1. This figure continues to show three curves: the corrected sump pH at the elevated sump temperature, the normalized sump pH at the standard temperature (25 °C), and the corrected sump pH at 25 °C. The "corrected pH at T_{sump}" curve continues to be used as the input to the spray lambda calculations. The description of this application and the justification for it supplied in Reference 7 continue to be valid for models associated with the proposed amendment.

As discussed in Section 4.4.10 of Reference 6, the sump pH curve is conservatively adjusted (or "corrected" between about 36 to 48 minutes) to account for the differences between the computer code and its benchmark data. This adjustment occurs when the boron concentration is greater than 3000 ppmB or the sodium concentration is less than 578 ppm. Note that the actual sump pH is significantly lower than the normalized sump pH due to the temperature differences. The minimum pH increases slightly under the proposed amendment while the equilibrium pH decreases slightly. The amount that the equilibrium pH decreases is smaller than the amount of increase in the minimum pH.

Reference 7 provided clarifying information for the sump pH analysis and supported the approval of full scope Alternative Source Term for McGuire in Reference 1. Other than the parameters listed in Table 3.2.7-1, Reference 7 remains valid under the proposed amendment. With regard to the discussion in Reference 7, there is no impact to the following modeled parameters:

- Reactor Coolant System lithium concentration
- Reactor Coolant System boron concentration
- Refueling Water Storage Tank boron concentration
- Cold Leg Accumulator volume
- Cold Leg Accumulator boron concentration
- Post accident radiation gamma (only) dose
- Ice condenser borax concentration

In addition, with the exception of the RWST, the volumes and masses provided in Reference 7 are also unaffected by the proposed amendment. Changes in the RWST volumes resulting from the amendment are compared to the CLB values in Table 3.2.7-1.

The ice condenser total ice melt mass is the same under the proposed amendment, but the time dependant profile of the ice melt is different. These profiles are compared in Table 3.2.7-2. There is no change to the cable insulation mass modeled or the types of cable insulation assumed. The conclusions in Reference 7 regarding the sensitivities of the sump pH model to these variables and regarding the variation in sump pH over the full 30 days (drawn from hand calculations) are not impacted by the proposed amendment. The concentration of the acids in the sump, under the amendment, is shown in Figure 3.2.7-2.

The equilibrium sump temperature has changed slightly with the proposed amendment. The CLB profile was reported in Reference 7 to be represented by the following piecewise function:

$T_{sump} = 228 - 128e^{-t}$ °F	$t < 100$ sec
$T_{sump} = 230.52 - 2.54*10^{-2}t + 2.54*10^{-6}t^2$ °F	$100 \text{ sec} \leq t \leq 5000$ sec
$T_{sump} = 167$ °F	$5000 \text{ sec} < t$

The initial sump temperature profile used in the analysis for the proposed amendment has not changed, but a conservative simplification has been applied to the profile later in time. After 2700 seconds, the temperature profile used in the sump pH analysis is assumed to be constant at the equilibrium temperature: 177 °F. At 2700 seconds, the sump temperature profile decreases past 177 °F. The predicted profile continues to fall and then slowly rises to equilibrium conditions at about two (2) hours. Thus, after 2700 seconds, the simplified sump temperature profile modeled in the sump pH analysis is conservative in comparison to the prediction because the modeled temperature is greater than or equal to the predicted temperature. The piecewise function above could be written for the proposed amendment as:

$T_{sump} = 228 - 128e^{-t}$ °F	$t < 100$ sec
$T_{sump} = 230.52 - 2.54*10^{-2}t + 2.54*10^{-6}t^2$ °F	$100 \text{ sec} \leq t < 2700$ sec
$T_{sump} = 177$ °F	$2700 \text{ sec} \leq t$

Table 3.2.7-3 provides the results of the sump pH analysis prior to, and after, the implementation of the amendment. In both cases, equilibrium pH conditions are achieved at approximately two (2) hours.

Table 3.2.7-1
Summary of Changes to the Sump pH Model
Comparison of Current Licensing Basis Case and
Proposed Amendment Model Parameters for Radiological Analyses

Parameter	Current Licensing Basis	Proposed Amendment	Discussion
RWST Volume Above Suction Line for Full Tank (gal)	347,000	377,000	Volume of water between minimum[(1)] full RWST level and the tank suction. For the sump pH analysis, this volume is conservatively based upon the maximum RWST volume. It bounds the amount of RWST water available which conservatively minimizes pH.
RWST Volume Above Suction Line at Low Level Setpoint (gal)	99,000	47,000	Change in volume reflects the change in RWST low level set point under the proposed amendment. For conservatism the low level setpoint is reduced to 80 inches for the sump pH analysis.
Maximum System Flow Rates Prior to Reaching RWST Low Level Setpoint (gpm) **Safety Injection** **CVCS** **RHR** **CSS**	 775 695 6425 9600	 800 825 6550 0	Maximum system flow rates during injection phase to RWST low level. Higher system flow rates reflect increased RWST inventory. Spray is not automatically started under the proposed amendment.
Maximum System Flow Rates Prior to Reaching RWST Low- Low Level Setpoint (gpm) **SI** **CVCS** **RHR** **CSS**	 0 0 0 9600	 800 825 0 0	Maximum system flow rates during injection phase from RWST low level setpoint to RWST low-low level setpoint. RHR is stopped at RWST low level under the proposed amendment. All suction flow from RWST ceases at low-low level setpoint.
Time of Equilibrium Sump Temperature (sec)	5000	2700	The equilibrium time is determined by the earliest time that the equilibrium temperature is reached in the transient. Under the proposed amendment this temperature is reached earlier than in the existing (CLB) case and the temperature is higher. Elevated cooling water (heat sink) conditions are assumed.

Note:

(1) RWST volume used is not the same amount modeled in Sections 3.2.1 and 3.2.8, but is conservative for the modeling of containment sump pH.

Table 3.2.7-2
Summary of Changes to the Sump pH Model
Comparison of Ice Melt in Current Licensing Basis and
Proposed Amendment Models

Time (sec)	**Mass of Ice Melt in Current Licensing Basis Analysis** (lbm)	**Mass of Ice Melt in Proposed Amendment Analysis** (lbm)
0	0	0
60	653,000	585,000
160	732,000	659,000
230	770,000	694,000
450	861,000	789,000
750	968,000	903,000
1400	1,156,000	1,139,000
1900	1,283,000	1,311,000
2400	1,384,000	1,462,000
2900	1,478,000	1,599,000
3400	1,581,000	1,704,000
4200	1,708,000	1,838,000
4800	1,788,000	1,883,000
5400	1,843,000	1,890,000
6000	1,879,000	1,890,000
6600	1,890,000	1,890,000
6610	1,890,000	1,890,000
end	1,890,000	1,890,000

Table 3.2.7-3
Comparison of the Normalized and Corrected Sump pH Analysis Results for the Current Licensing Basis and Proposed Amendment Models

Output Parameter	Current Licensing Basis	Proposed Amendment
Minimum sump pH	7.3	7.4
Equilibrium sump pH	7.8	7.7

Figure 3.2.7-1
McGuire LBLOCA Sump pH Response for Proposed Amendment

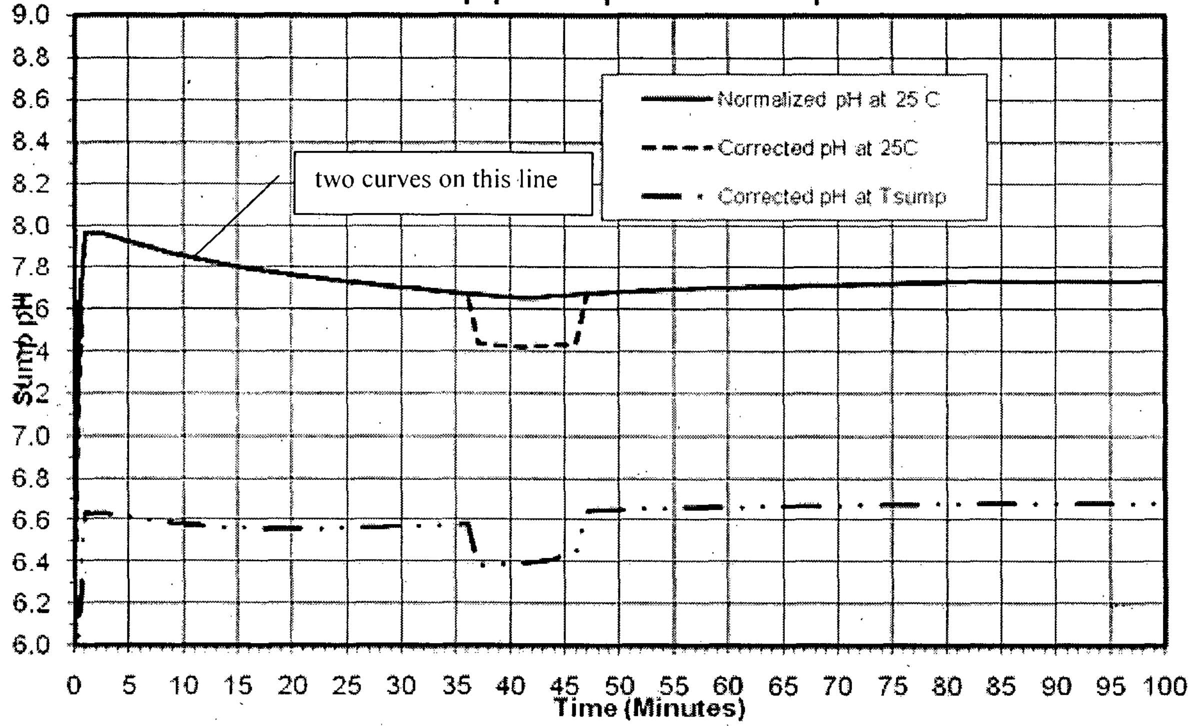
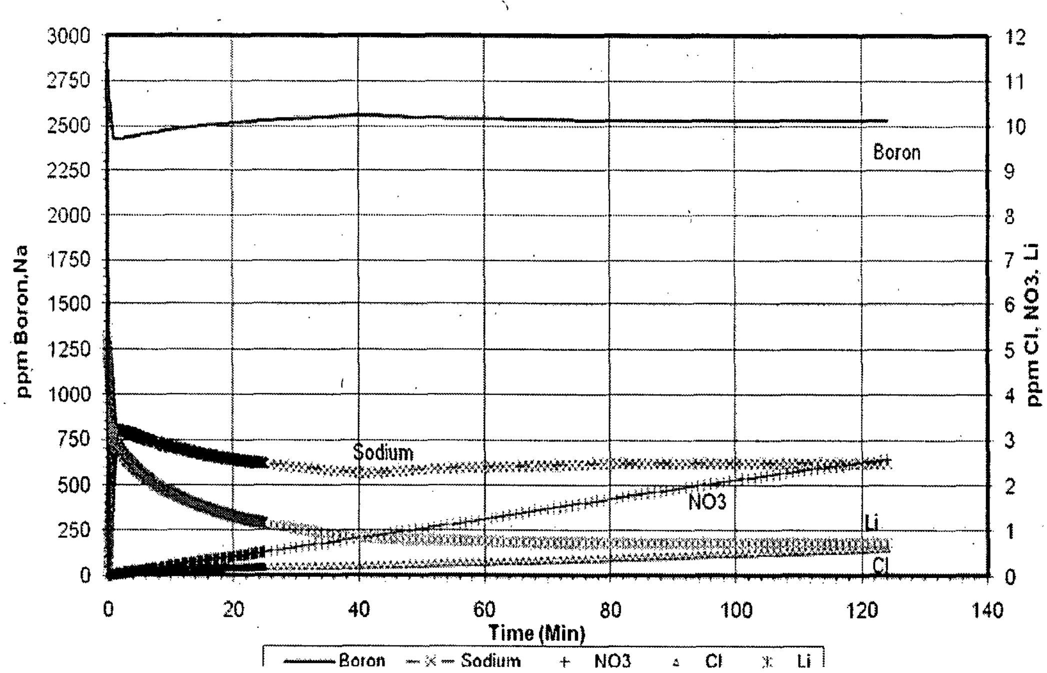


Figure 3.2.7-2
McGuire LBLOCA Sump Concentrations



3.2.8 Radiological Consequences Analysis of a LOCA with Proposed Amendment

3.2.8.1 *Methodology and Overview*

The analysis of the radiological consequences of the proposed amendment uses the same methodology previously reviewed by the NRC (References 1 and 5). However, some of the specifics of the model and the timing of system responses are changed. In addition, the newest version of LOCADOSE is employed (Version 7.1, Reference 8). The base LOCADOSE models (containment release and ECCS release) used for the current licensing basis analysis were used as the starting point for the generation of the proposed amendment models. Changes were made only to those parameters impacted by the proposed amendment. Changes were made to the timing and the sequence of some of the system responses, including the spray model, the annulus ventilation model, and the ECCS back-leakage model.

The proposed amendment was not found to impact or change the limiting single failure scenario of Minimum Safeguards. This failure scenario results in the loss of one train of Emergency Safeguards systems and the loss of one train of other systems which mitigate LOCA radiological consequences. Effectively, the Minimum Safeguards scenario results in the availability and response of only one train, fan, or pump associated with the ARS, the CSS, the AVS, and the CRAVS.

A slight modification to the single failure impact to the ECCS back-leakage model was made for conservatism; however, it results in an inconsistency between the ECCS release model and the containment release model. In the Minimum Safeguards scenario, it would logically follow that one train of CVCS, RHR, and SI would respond to the LOCA. But, only for the purpose of determining the time that ECCS back-leakage starts (time of RWST low level), this analysis assumes that two trains of these systems respond. Modeling two trains conservatively empties the RWST quicker which causes ECCS back-leakage releases to start earlier.

An ECCS Water Management LAR was previously submitted for Catawba (Reference 4). In developing the McGuire analysis, Duke Energy desired to maintain consistency between the Catawba and McGuire models. This effort resulted in a small increase in the amount of conservatism relative to what a McGuire specific analysis would have yielded.

The scenario involving the proposed amendment affects the following parameters in the radiological consequences analysis of a LOCA at McGuire:

- Spray lambdas
- Sump pH
- The timing of the exhaust and recirculation cycles of the Annulus Ventilation System
- The time dependent sump level (volume) profile
- The time that ECCS back-leakage begins
- Partitioning factors for ECCS releases to the RWST and to the Auxiliary Building

All other parameters are unaffected including the source term, its release timing, the response of the ARS system, containment leakage modeling, control room ventilation system modeling, atmospheric dispersion, ECCS leakage rates, filtration models, and release locations. Each of the impacted parameters will be discussed later; and the new values associated with the proposed amendment will be provided. All other features of the model are unchanged from those described in Reference 1.

3.2.8.2 *Sequence of Events*

The original plant design included automatic spray initiation in response to a high energy release into containment (increase in containment pressure). The CSS was automatically started shortly after the release into (lower) containment. Analytically, initial spray into upper containment from the RWST did not have an impact on the isotopic release (initially into lower containment) until the ARS started later in the accident (at 10 minutes). The CSS was automatically started taking suction on the RWST which was emptied within the first hour of the accident response. RHR auxiliary spray was then manually started by the operators who then aligned the CSS to sump recirculation after emptying the RWST. So, within the first hour the plant had exhausted RWST inventory and was on sump recirculation for spray and decay heat (RHR System) removal. ECCS leakage was postulated to start at the time that the realignment to sump recirculation began.

The proposed amendment removes the automatic start of the CSS. A single CS pump (taking suction on the sump) is started manually by the operators after the RWST reaches the low level setpoint. The RWST is, therefore, dedicated to injection during the immediate plant response to the event. The ARS system is not impacted by the amendment and is modeled to start, as in the base case, to promote the exchange of atmospheres between upper and lower containment. With the proposed amendment, however, ARS starts prior to the introduction of spray flow into upper containment. The operators manually start the CSS in sump recirculation (conservatively modeled at 80 minutes after accident initiation). However, only one CS pump is utilized. RHR auxiliary spray is not utilized at any time in the amendment scenario. A lower spray flow rate and, thus, lower (although more prolonged) spray lambdas result. The initial spray effectiveness is increased due to the presence of a significant amount of activity in upper containment at the time spray flow starts.

The AVS starts and runs as previously modeled, however, the change in the thermodynamics associated with the plant's proposed amendment LOCA response modifies the durations of the exhaust and recirculation cycles. The AVS response has been remodeled for the proposed amendment.

The sequence of events is summarized and contrasted with the base case in Table 3.2.8-1.

Table 3.2.8-1
Sequence of Events for Radiological Models of LOCA Scenarios
(times in seconds)

Event	Current Licensing Basis	Proposed Amendment
Radiological Models of LOCA initiation Reactor trip Safety injection signal Begin containment leakage Minimum Safeguards failure (scenario initiation) One closed CRAVS outside air inlet path (initial condition) Containment Isolation begins Release (Tech Spec) reactor coolant water	0	0
Containment Air Addition & Release System isolated	4	4
Begin control room pressurization	11	11
Begin gap source release Control room pressurized	30	30
Start AV System (in exhaust mode)	39	39
Annulus vacuum established	71	71
Automatic CS System Start	120	N/A
Start AR System	600	600
Begin early in-vessel source release	1800	1800
End gap source release	1830	1830
Start ECCS leakage	3000	2160
Begin single pump RHR auxiliary spray from sump	3000	N/A
Transfer suctions from injection to sump recirculation	3240	3434
Manual CS System Start	3240[1]	4800
End early in-vessel source release	6480	6480
Particulate Iodine DF>50 (reduce particulate spray lambda by factor of 10)	7100	8000
Elemental Iodine DF>200 (cease elemental spray credit)	46,000	104,000
Stop CS system (cease all spray credit) Lower containment leakage rate to half	86,400	86,400
End 30 day releases, end scenario	2,592,000	2,592,000

[1] Operators manually restart the CS System from the sump after switchover is complete

3.2.8.3 Partitioning Factors for ECCS Back-leakage to the RWST

The partitioning factors associated with the ECCS releases are taken from the Catawba amendment LOCA analysis, as they were for the baseline (CLB) case. An evaluation of the differences between the significant parameters for McGuire and Catawba was performed in Reference 6. The physical properties of the plants have not changed; however, the post LOCA pH and sump temperature responses have changed. The minimum pH is essentially the same for both plants (albeit the corrected McGuire pH is slightly higher by about five hundredths of a pH unit) and the equilibrium corrected McGuire post LOCA pH is slightly higher (about six hundredths of a pH unit) than the Catawba pH. (All proposed amendment related values for Catawba are from Reference 4.) The sump equilibrium temperature used for the Catawba analysis (185° F) is higher than the predicted McGuire post LOCA sump pH analysis sump equilibrium temperature (177° F). The McGuire sump pH continues to be slightly higher and its sump equilibrium temperature slightly lower than for Catawba, so the Catawba post LOCA partitioning model input continues to be limiting and it can continue to be conservatively adopted for the McGuire LOCA analysis, as was concluded for the CLB case in Reference 6.

Due to plant differences, the postulated failures are not the same for both plants. Nevertheless, none of the postulated Catawba failure scenarios used to produce partitioning values in Reference 4 was discarded when determining which set to adopt as McGuire values. The difference in values for the partitioning cases is small, so the most conservative factors were adopted, as was done for the base (CLB) analysis (Reference 6). The partitioning factors generated for the Catawba RWST releases have an additional conservatism installed. The computations for the amendment scenario and the non amendment scenario (those used in the Catawba CLB analysis, Reference 9) were compared and the greater of the two release fractions (from the computer code) was taken for each time-step.

The partitioning factors for the RWST releases are very low and the impact from RWST releases, ultimately, is not very substantial. From the time of sump recirculation until two (2) hours, the RWST iodine partitioning factors will be lower with the proposed amendment because of the later start of recirculation and ECCS back-leakage. By two (2) hours, the impact of the smaller initial tank inventory and higher sump water temperature causes amendment RWST iodine partition fractions to become larger than the baseline values. The back-leakage rate to the RWST remains 20 gpm. This leakage begins at 2160 seconds as discussed in Section 3.2.8.4.

The RWST partitioning model and a comparison of the release rates for CLB and the proposed amendment case are provided in Table 3.2.8-2.

Table 3.2.8-2
RWST Release Model for 20 gpm ECCS Back-leakage

Time-steps		Current Licensing Basis		Proposed Amendment	
Start Time (sec)	**End Time (sec)**	**IODEX release fraction**	**Release Rate (cfm)**	**IODEX release fraction**	**Release Rate (cfm)**
0	790	0	**0**	0	**0**
790	810	9.197E-11	**2.459E-10**		
810	900	2.894E-09	**7.739E-09**		
900	1200	3.443E-08	**9.207E-08**		
1200	1400	9.799E-08	**2.620E-07**		
1400	1800	1.772E-07	**4.738E-07**		
1800	2160	3.486E-07	**9.321E-07**		
2160	3600	3.486E-07	**9.321E-07**	1.049E-06	**2.805E-06**
3600	4800	4.228E-07	**1.131E-06**	1.111E-06	**2.970E-06**
4800	6000	4.128E-07	**1.104E-06**	1.044E-06	**2.791E-06**
6000	7200	3.916E-07	**1.047E-06**	9.723E-07	**2.600E-06**
7200	28,800	3.376E-07	**9.027E-07**	1.099E-06	**2.938E-06**
28,800	36,000	3.284E-07	**8.781E-07**	1.586E-06	**4.240E-06**
36,000	86,400	1.873E-07	**5.008E-07**	1.179E-06	**3.152E-06**
86,400	345,600	3.444E-07	**9.209E-07**	8.273E-06	**2.212E-05**
345,600	2,592,000	6.388E-06	**1.708E-05**	1.230E-05	**3.289E-05**

3.2.8.4 Modeled Time of ECCS Back-leakage Initiation

ECCS back-leakage does not begin until the plant has entered sump recirculation. In the amendment scenario, the initial response (injection) to the accident takes water from the RWST. Pump suctions are not reconfigured for sump recirculation until the RWST low level setpoint is reached. Conservatively, it is also assumed that ECCS back-leakage begins at the time that this set point is reached (instantaneous realignment to sump recirculation).

The limiting scenario for the radiological consequences analysis involves the response of a single train of ECCS. However, in order to bound the potential ECCS back-leakage initiation times, and to be consistent with the Catawba amendment model (Reference 4), two trains of SI, CVCS and RHR are assumed to respond to the LOCA in the immediate plant response for the ECCS leakage release model (only). In determining the time to start ECCS releases, it was conservatively assumed that the RWST is at its minimum full level and that two trains of ECCS (SI, CVCS and RHR) start, even though it is assumed that one ECCS train has failed at the initiation of the accident through a (single) failure. Thermal/hydraulics modeling of the response to the LOCA determined that the time to RWST low level setpoint from a two train ECCS initiation is 2245 seconds. For a one train response, the time to RWST low level is 3434 seconds.

These models include time for system and equipment response to the LOCA. ECCS recirculation flow, however, is not expected to start for at least another 95 seconds once the low level setpoint is reached.

A minimum time to sump recirculation can be computed assuming instantaneous system and equipment response. The useable volume in the RWST between the proposed Technical Specification minimum water level of 470 inches and its proposed new RWST low level setpoint is 280,700 gallons. The maximum combined two train flow ECCS flow from the CVCS, SI, and RHR pumps is 7840 gpm. Thus, the elapsed time (assuming instantaneous system and equipment response) to exhaust the useable volume of the tank is (280,700 gallons / 7840 gpm) 35.8 minutes or 0.597 hrs (2148 seconds). Based upon this analysis, the time to the start of ECCS back-leakage is assumed to be six-tenths hours (2160 seconds). This start time is very conservative relative to the expected plant response for either a one or a two train ECCS response and corresponds to the time assumed for the Catawba analysis and its associated RWST partitioning model (Reference 4). This value is conservative relative to the expected response time and to the thermal/hydraulic model predicted time.

3.2.8.5 Partitioning Factors for ECCS Back-leakage to the Auxiliary Building

The same methodology from both the Catawba and McGuire CLB analyses (References 1 and 10) was used for the proposed amendment modeled partitioning of ECCS leakage to the Auxiliary Building. This partitioning model is taken from work done for the Catawba amendment LOCA analysis (Reference 9). It examined several different cases, some of which are not applicable to McGuire. As was done in the McGuire CLB analysis, the partitioning factors were adopted without examination as to the case most applicable to McGuire. Instead, as additional conservatism, the set of partitioning factors which results in the largest releases is adopted. The same scenario case which yielded the largest values for the CLB analysis also yielded the largest values under the proposed amendment. The comparison of the main McGuire and Catawba parameters associated with this the determination of the partitioning factors performed in Reference 6 is still relevant, even though there have been some slight changes to the sump temperature and sump pH. The relative relationship between the two sites for these sump parameters remains the same. The modeled release rate continues to be 1 gpm, which is twice the operational leakage rate. The difference between the release fractions is that the amendment fraction in the second time-step is slightly greater than in the non amendment case. But, both sets are nearly identical.

The partitioning factors for the CLB case and proposed amendment are compared in Table 3.2.8-3.

Table 3.2.8-3
Design Basis Iodine Partition Fractions and Release Rates for 1 gpm ECCS Component Leakage into the McGuire Auxiliary Building

Time-step		Current Licensing Basis		Proposed Amendment	
Start Time (hr)	**End Time** (hr)	**Iodine Partition Factor**	**Release Rate** (cfm)	**Iodine Partition Factor**	**Release Rate** (cfm)
0	3	0.100	**0.01337**	0.100	**0.01337**
3	72	0.028	**0.00374**	0.031	**0.00414**
72	720	0.010	**0.001337**	0.010	**0.001337**

3.2.8.6 <u>Spray Removal Model</u>

The automatic spray function is removed by the proposed amendment so the system does not start in response to the increase in containment pressure at the beginning of the accident. Manual start of CS by the control room operators 80 minutes after the start of the accident is assumed. This time bounds the operator manual spray start time (the time to reach the RWST low-low level setpoint based upon minimum ECCS performance) of approximately one (1) hour. Once the system is started, only one spray pump is credited by the proposed amendment. With the Minimum Safeguards failure, only one spray pump would be available, so plant operation continues to be bounded by the model. The delayed (manual) CS pump start removes the RWST as a suction source, so CS will only be used in sump recirculation. RHR auxiliary spray will not be used when the amendment is implemented, so it is not included in the spray model and it is not credited in this analysis.

The Containment Air Return Fans and Ventilation System are not impacted by the proposed amendment. One fan continues to start automatically at 600 seconds (as modeled in Reference 1) with the Minimum Safeguards failure. Air is circulated from lower containment to upper containment (through the non-credited ice condensers) and back to lower containment.

The one train amendment spray model is provided in Table 3.2.8-4.

Table 3.2.8-4
Spray Lambda Comparison for Current Licensing Basis and Proposed Amendment Cases (One Train of Spray with Minimum Safeguards Failure)

Start Time (sec)	End Time (sec)	Elemental Spray Lambda: Current Licensing Basis (hr^{-1})	Elemental Spray Lambda: Proposed Amendment (hr^{-1})	Particulate Spray Lambda: Current Licensing Basis (hr^{-1})	Particulate Spray Lambda: Proposed Amendment (hr^{-1})
0	600 [4]	**0**	**0**	**0**	**0**
600 [4]	3000	**20**	**0**	**9.36**	**0**
3000	3240	**0.22**	**0**	**7.19**	**0**
3240	3500	**0.50**	**0**	**16.5**	**0**
3500	4000	**0.53**	**0**	**16.5**	**0**
4000	4500	**0.56**	**0**	**16.5**	**0**
4500	4800	**0.58**	**0**	**16.5**	**0**
4800	5000	**0.58**	**0.27**	**16.5**	**9.36**
5000	7100	**0.59**	**0.27**	**16.5**	**9.36**
7100	8000	**0.59**	**0.27**	**1.65** [1]	**9.36**
8000	24,600	**0.59**	**0.27**	**1.65** [1]	**0.94** [1]
24,600	30,000	**0.58**	**0.27**	**1.65** [1]	**0.94** [1]
30,000	40,000	**0.56**	**0.26**	**1.65** [1]	**0.94** [1]
40,000	46,000	**0.53**	**0.26**	**1.65** [1]	**0.94** [1]
46,000	70,000	**0 (no credit)** [2]	**0.26**	**1.65** [1]	**0.94** [1]
70,000	80,000	**0 (no credit)** [2]	**0.25**	**1.65** [1]	**0.94** [1]
80,000	86,400	**0 (no credit)** [2]	**0.23**	**1.65** [1]	**0.94** [1]
86,400	end	**0 (no credit)** [3]	**0 (no credit)** [2,3]	**0 (no credit)** [3]	**0 (no credit)** [3]

1 The particulate spray lambdas are reduced by a factor of 10 for reduced spray effectiveness due to particulate spray washout at DF of 50. In CLB this occurs at 7100 seconds, at 8000 seconds with the proposed amendment.

2 Spray washout for elemental iodines (DF reaches 200) occurs at 46,000 seconds in CLB and at 104,000 seconds in with the proposed amendment. This is predicted to occur after spray ceases to be credited at 24 hours, so full elemental removal credit is not taken.

3 Spray is not credited for any iodine removal after 24 hours (86,400 seconds).

4 In current licensing basis, spray is modeled to start at 120 seconds but not credited until 600 seconds when containment air recirculation fan starts.

3.2.8.7 Annulus Ventilation System Model

The CANVENT Annulus Ventilation System (AVS) response model used for the CLB analysis was updated for the amendment scenario. Uncertainties associated with the annulus pressure instrumentation train were also updated. This changed the modeled annulus pressure for establishment of annulus vacuum from -0.90 inwg (Reference 1) to -0.97 inwg. The impact of this uncertainty change and of the different thermodynamic conditions in containment and in the annulus during the amendment scenario is small. The predicted depletion time associated with the proposed amendment was nearly identical to that of the base analysis. The time to annulus vacuum in the amendment scenario was (conservatively) rounded up to the next whole second, so the modeled time is 71 seconds which is unchanged from that computed in the CLB AVS (CANVENT) model.

The AVS model for the proposed amendment is provided in Table 3.2.8-5. The model for the CLB case is found in Table 9 of Reference 6.

Table 3.2.8-5
Annulus Ventilation System Model for Proposed Amendment
(One VE Fan with Minimum Safeguards Failure)

Sequence Number	Initiation of Discharge (sec)	Duration of Exhaust (sec)	Initiation of Recirc (sec)	Duration of Recirc (sec)	Volumetric Flow Rate (cfm)	Quantity Discharged (ft3)
1	39	122	161	25	7200	14640
2	186	85	271	27	7200	10200
3	298	59	357	31	7200	7020
4	388	46	434	37	7200	5520
5	471	39	510	42	7200	4680
6	552	35	586	48	7200	4140
7	634	32	666	54	7200	3780
8	720	30	750	61	7200	3540
9	811	28	839	67	7200	3360
10	906	27	933	73	7200	3240
11	1006	27	1033	78	7200	3180
12	1111	26	1137	82	7200	3120
13	1219	26	1244	83	7200	3060
14	1327	26	1353	85	7200	3060
15	1438	26	1464	86	7200	3060
16	1550	26	1575	88	7200	3060
17	1663	25	1688	94	7200	3000
18	1782	25	1806	107	7200	2940
19	1913	24	1937	115	7200	2880
20	2052	24	2076	117	7200	2820
21	2193	24	2217	118	7200	2820
22	2335	24	2359	119	7200	2820
23	2478	24	2501	119	7200	2820

Table 3.2.8-5
Annulus Ventilation System Model for Proposed Amendment
(One VE Fan with Minimum Safeguards Failure)

Sequence Number	Initiation of Discharge (sec)	Duration of Exhaust (sec)	Initiation of Recirc (sec)	Duration of Recirc (sec)	Volumetric Flow Rate (cfm)	Quantity Discharged (ft3)
24	2620	24	2643	119	7200	2820
25	2762	24	2786	118	7200	2820
26	2904	24	2928	118	7200	2820
27	3046	24	3070	118	7200	2820
28	3188	24	3211	115	7200	2820
29	3326	24	3349	110	7200	2820
30	3459	24	3483	108	7200	2880
31	3591	24	3615	106	7200	2880
32	3721	24	3745	104	7200	2880
33	3849	24	3873	101	7200	2880
34	3974	25	3999	101	7200	2940
35	4100	25	4124	104	7200	2940
36	4228	24	4252	106	7200	2880
37	4358	24	4382	110	7200	2880
38	4492	24	4516	111	7200	2880
39	4627	24	4651	111	7200	2820
40	4762	24	4785	112	7200	2820
41	4897	24	4921	112	7200	2820
42	5033	24	5056	112	7200	2820
43	5168	24	5192	112	7200	2820
44	5304	24	5327	115	7200	2820
45	5442	24	5466	120	7200	2820
46	5586	24	5609	125	7200	2820
47	5734	23	5757	126	7200	2760
48	5883	23	5906	129	7200	2760
49	6035	23	6058	129	7200	2760
50	6187	23	6210	130	7200	2760
51	6340	23	6363	130	7200	2760
52	6493	23	6516	130	7200	2760
53	6646	23	6669	130	7200	2760
54	6799	23	6822	130	7200	2760
55	6952	23	6975	131	7200	2760
56	7106	23	7129	130	7200	2760
57	7259	23	7282	131	7200	2760

Table 3.2.8-5
Annulus Ventilation System Model for Proposed Amendment
(One VE Fan with Minimum Safeguards Failure)

Sequence Number	Initiation of Discharge (sec)	Duration of Exhaust (sec)	Initiation of Recirc (sec)	Duration of Recirc (sec)	Volumetric Flow Rate (cfm)	Quantity Discharged (ft3)
58	7413	23	7436	131	7200	2760
59	7567	23	7590	131	7200	2760
60	7721	23	7744	131	7200	2760
61	7875	23	7898	131	7200	2760
62	8029	23	8052	131	7200	2760
63	8183	23	8206	131	7200	2760
64	8337	23	8360	131	7200	2760
65	8491	23	8514	132	7200	2760
66	8646	23	8669	131	7200	2760
67	8800	23	8823	131	7200	2760
68	8954	23	8977	132	7200	2760
69	9109	23	9132	131	7200	2760
70	9263	23	9286	132	7200	2760
71	9418	23	9441	131	7200	2760
72	9572	23	9595	131	7200	2760
duration of accident		23		131	7200	2760

3.2.8.8 *Sump Level Profile*

The case associated with the proposed amendment employs a time dependent sump profile derived for the amendment scenario. The sump volume builds early in the accident, peaks and then declines slightly. The model value chosen for each time period is equal to or lower than the predicted values for that entire period. This conservatively bounds the sump level prediction over the time period because a lower volume will produce a greater activity concentration. A steady state value is conservatively chosen to be lower than the volume at the end of the curve. Therefore, a bounding time dependent sump volume curve based upon the expected plant response is used in the amendment radiological consequences model.

Table 3.2.8-6 contrasts the CLB and proposed amendment sump volume predictions.

Table 3.2.8-6
Time Dependant Containment Sump Water Volume Models For Radiological Analyses

Time (sec)	Current Licensing Basis Sump Volume (ft^3)	Proposed Amendment Sump Volume (ft^3)
0	0	0
45	19,000	51,573*
1560	56,240	51,573*
1800	59,600	51,573*
1830	60,020	51,573*
2100	60,020	51,573
3000	72,140	63,510
3600	74,075	70,484
4800	76,900	74,760
6000	77,300	77,000
8700	77,400	77,000
10,200	77,600	77,000
16,600	77,600	76,000
28,800	77,600	75,000

* Sump volume does not impact the problem or its results until the time of ECCS leakage is reached. The code requires a volume for this node, so the sump node volume prior to the start of ECCS leakage is set to the sump volume at the time that ECCS begins.

3.2.8.9 Results

Table 3.2.8-7 shows the results of the analysis of the radiological consequences associated with the proposed amendment and compares them to the CLB results. The shine component is unchanged because that work was done in anticipation of the amendment initiative and so allowances for it were made when the model was developed. The discussion and evaluation of direct shine in References 6 and 10 remains valid for the proposed amendment.

Table 3.2.8-7
Comparison of Radiological Consequences Results for the Base and Proposed Amendment Scenarios (Rem TEDE)

	Base Case			Proposed Amendment		
	EAB	**LPZ**	**Control Room**	**EAB**	**LPZ**	**Control Room**
Containment Leakage	8.15	1.67	2.19	10.92	1.98	2.70
ECCS Leakage	1.31	0.23	0.80	1.33	0.25	0.90
Total Dose (not airborne)	9.46	1.90	2.99	12.25	2.23	3.60
Direct Shine			1.26			1.26
Total Dose	**9.46**	**1.90**	**4.25**	**12.25**	**2.23**	**4.86**
Limit	25	25	5	25	25	5

The period of maximum releases/dose for the containment release is from six-tenths to two and six-tenths (0.6 - 2.6) hours for both cases.

The period of maximum release/dose for the ECCS release is one to three (1.0 - 3.0) hours for both cases.

3.2.9 Peak Clad Temperature LOCA Analysis

The proposed changes will not impact the LOCA analysis performed to determine the peak clad temperature. This analysis, presented in UFSAR Section 15.6.5, is a relatively short term analysis that terminates during the cold leg injection phase of a LOCA. The proposed changes will extend the duration of cold leg injection. Therefore, the current calculated peak clad temperatures are not affected by the proposed changes.

The proposed change to CS will not adversely impact the minimum containment pressure analysis included in the peak clad temperature analysis. The absence of CS would be expected to increase the minimum containment pressure as a function of time. However, for ice condenser plants, the increase in containment pressure resulting from the elimination of CS would be limited.

3.2.10 Impact to UFSAR Chapter 15 Category III and IV Events

The proposed modifications listed below were evaluated for potential impact to the UFSAR Chapter 15 Category III and IV events as identified in UFSAR Section 15.0.

- Increased initial RWST TS liquid inventory
- Decreased RWST low level alarm setpoint
- Decreased RWST low-low level alarm setpoint
- Elimination of the automatic CSS actuation
- Revisions to EPs

The listing of the UFSAR Chapter 15 events evaluated follows:

1. Steam system piping failure (Section 15.1.5)

   Large and small steam line breaks may occur either inside or outside the containment building. Breaks located outside containment do not currently result in a CS actuation, and are therefore unaffected by the proposed change. UFSAR Section 15.1.5 is primarily concerned with the core response resulting from the increase in steam flow due to the steam line break. The increase in steam flow causes a decrease in the RCS temperature, which due to a negative moderator temperature coefficient, results in an increase in core thermal power. The core power increase is mitigated by the Reactor Protection System (RPS) and rapid isolation of main feedwater. The evaluation determines the fraction of fuel experiencing a Departure from Nucleate Boiling (DNB), which is translated into a failed fuel fraction. This fraction is input to an analysis to ensure the dose limits are satisfied. The limiting dose analysis assumes the break is located outside containment.

   The proposed changes to the RWST and CS actuation logic primarily affect the containment response. Variations in containment pressure will not affect the RCS overcooling due to choked conditions being present at the steam line break location. Therefore, the core response calculations are not affected by the proposed modifications.

2. Feedwater system pipe break (Section 15.2.8)

   Large and small feedwater system pipe breaks may occur either inside or outside the containment building. Breaks located outside containment do not currently result in a CS actuation, and are therefore unaffected by the proposed change. Feedwater system pipe breaks can have a variety of effects. Depending upon the size of the break and the plant operating conditions at the time of the break, the break could cause either a cooldown or a heatup of the RCS. Overcooling of the RCS due to a secondary side pipe rupture is evaluated in Section 15.1.5. UFSAR Section 15.2.8 evaluates the RCS heatup effects due to a secondary side pipe rupture.

   A feedwater line rupture reduces the ability to remove heat generated by the core from the RCS. Section 15.2.8 is primarily concerned with establishing that adequate feedwater is available from the Auxiliary Feedwater System to prevent a substantial overpressurization of the RCS and that sufficient liquid is maintained in the RCS to provide adequate decay heat removal. The Section 15.2.8 evaluation focuses entirely on the conditions within the RCS. The containment response resulting from a feedwater line break is not considered in Chapter 15, but is bounded by the LOCA and steam line break analyses presented in Chapter 6.

   The proposed modifications involve changes to CS actuation and RWST inventory. Therefore, the proposed modifications will not affect the results of this UFSAR section.

3. Complete loss of forced reactor coolant flow (Section 15.3.2)

   The evaluation performed for Section 15.3.2 considers the core response to a loss of forced reactor coolant flow. The primary concern evaluated is the decrease in the heat transferred from the fuel, and the potential for fuel rods to experience DNB. The fraction of fuel experiencing DNB is translated into a failed fuel fraction. This fraction is input to an analysis to ensure the dose limits are satisfied.

The proposed modifications involve changes to CS actuation and RWST inventory. This event does not involve a high energy release into containment and thus does not result in CS actuation. The available RWST inventory similarly does not play a role in this event. Therefore, the proposed modifications will not affect the results of this UFSAR section.

4. Rod cluster control assembly misoperation (single rod cluster control assembly withdrawal at full power) (Section 15.4.3).

   There are four Rod Cluster Control Assembly (RCCA) misoperation events described in Section 15.4.3. These are: a) one or more dropped RCCAs within the same group, b) a dropped RCCA bank, c) a statically misaligned RCCA, and d) withdrawal of a single RCCA. Of these events, only the last one is a Category III event.

   The withdrawal of a single RCCA results in a core power increase. This is a relatively short duration event terminated by RPS action. The evaluation determines the fraction of fuel experiencing DNB, which is translated into a failed fuel fraction. This fraction is input to an analysis to ensure the dose limits are satisfied.

   The proposed modifications involve changes to CS actuation and RWST inventory. This event does not involve a high energy release into containment and thus does not result in CS actuation. The available RWST inventory similarly does not play a role in this event. Therefore, the proposed modifications will not affect the results of this UFSAR section.

5. Inadvertent loading and operation of a fuel assembly in an improper position (Section 15.4.7)

   The inadvertent loading and operation of a fuel assembly event evaluation is primarily concerned with the local neutron flux peaks in the fuel pins. There are no radiological consequences associated with the inadvertent loading and operation of a fuel assembly in an improper position, since activity is contained within the fuel rods and the RCS remains within design limits.

   The proposed modifications involve changes to CS actuation and RWST inventory. This event does not involve a high energy release into containment and thus does not result in CS actuation. The available RWST inventory similarly does not play a role in this event. Therefore, the proposed modifications will not affect the results of this UFSAR section.

6. Small break LOCA (Section 15.6.5)

   The small break LOCA event is evaluated to ensure compliance with the criterion provided in 10 CFR 50.46. The small break event considered in Section 15.6.5 is defined as a rupture of the RCS pressure boundary with a total cross-sectional area less than 1.0 ft^2 in which the normally operating charging system flow is not sufficient to sustain pressurizer level and pressure. The proposed modifications will affect components that function during the small break LOCA analyses. Each of the modifications is discussed individually below.

The proposed modification to remove the automatic CSS actuation logic will not impact the small break LOCA analysis. During a small break LOCA, RCS pressure remains elevated relative to the containment pressure. The elevated RCS pressure limits the ECCS injected into the RCS and extends the time frame during which break flow exceeds ECCS injection. The break flow characteristics are choked, and therefore independent of the downstream pressure.

The current small break LOCA analysis determines the time at which the RWST low level alarm is expected, and simulates a transition from cold leg injection to sump recirculation. Once in sump recirculation, the high head ECCS pumps are aligned to the RHR pump discharge. Sump liquid is pumped by the RHR pumps, through the RHR heat exchangers where it is cooled and supplied to the high head ECCS pumps. The end result is an increase in the ECCS injection temperature.

The proposed modifications to the RWST will increase the amount of liquid available for ECCS injection. The modification to remove the automatic CSS actuation will reduce the total flow rate depleting the RWST inventory. Both of these changes will extend the duration of the cold leg injection phase of the event, which would represent a net benefit for the small break LOCA analysis. Therefore, the proposed changes will not adversely impact the results of this UFSAR section.

7. Radioactive gas waste system leak or failure (Section 15.7.1)

   The accident is defined as an unexpected and uncontrolled release of radioactive xenon and krypton fission product gases stored in a waste gas decay tank as a consequence of a failure of a single gas decay tank or associated piping. The gas decay tanks and associated piping are not located within the containment building. Therefore, the proposed modifications to CS and the RWST will not affect the results of this UFSAR section.

8. Radioactive liquid waste system leak or failure (Section 15.7.2)

   The accident is defined as an uncontrolled atmospheric release from the 112,000 gallon recycle holdup tank due to the postulated rupture of the tank. The recycle holdup tank is not located within the containment building. Therefore, the proposed modifications to CS and the RWST will not affect the results of this UFSAR section.

9. Postulated radioactive releases due to tank failures (Section 15.7.3)

   The accident is defined as an uncontrolled atmospheric release from the 395,000 gallon RWST due to the postulated rupture of the tank. The analysis assumes the entire contents of the RWST are released and ensures that the associated radiological consequences are within acceptable limits. The proposed modifications include changes to the RWST liquid volume specifications. These changes affect the minimum RWST volume that may be credited in the safety analyses. The analysis presented in Section 15.7.3 assumes the full volume of the RWST, which is not affected by the proposed modifications. Therefore, the proposed modifications to CS and the RWST will not affect the results of this UFSAR section.

10. Spent fuel cask drop accidents (Section 15.7.5)

The spent fuel pool and associated casks are not located in the containment building. Therefore, the proposed modifications to CS and the RWST will not affect the results of this UFSAR section.

11. Reactor coolant pump shaft seizure (locked rotor) (Section 15.3.3)

The evaluation performed for Section 15.3.3 considers the core response to a reactor coolant pump shaft seizure. This event causes a more severe loss of forced core cooling flow than the complete loss of forced coolant flow event described in Section 15.3.2. The primary concern evaluated is the decrease in the heat transferred from the fuel, and the potential for fuel rods to experience DNB. The fraction of fuel experiencing DNB is translated into a failed fuel fraction. This fraction is input to an analysis to ensure the dose limits are satisfied.

The proposed modifications involve changes to CSS actuation and RWST inventory. This event does not involve a high energy release into containment and thus does not result in CSS actuation. The available RWST inventory similarly does not play a role in this event. Therefore, the proposed modifications will not affect the results of this UFSAR section.

12. Reactor coolant pump shaft break (Section 15.3.4)

Section 15.3.4 considers the core response to a reactor coolant pump shaft break. This event is a less severe loss of forced core cooling flow than the event described in Section 15.3.3. This event is not specifically evaluated as it is bounded by Section 15.3.3.

The proposed modifications involve changes to CSS actuation and RWST inventory. This event does not involve a high energy release into containment and thus does not result in CSS actuation. The available RWST inventory similarly does not play a role in this event. Therefore, the proposed modifications will not affect the results of this UFSAR section.

13. Spectrum of rod cluster control assembly ejection accidents (Section 15.4.8)

This accident is defined as the mechanical failure of a control rod mechanism pressure housing resulting in the ejection of a RCCA and drive shaft. The consequence of this mechanical failure is a rapid positive reactivity insertion together with an adverse core power distribution, possibly leading to localized fuel rod damage.

The primary focus of the analysis described in Section 15.4.8 is the mechanical, neutronic, and thermal-hydraulic response to the rapid reactivity insertion. The results of this analysis define a failed fuel fraction which is input to an analysis to ensure the dose limits are satisfied. These calculations are performed for a relatively short duration to capture the fuel rod performance prior to RPS actuation.

The containment response aspects of this event resulting from the break on the control rod housing are bounded by the Chapter 6 LOCA analysis results.

The proposed modifications will not affect the core related calculations presented in this UFSAR section. The associated dose analysis does not credit the actuation of CSS. Therefore, the proposed modifications will not affect the results of this UFSAR section.

14. Steam generator tube failure (Section 15.6.3)

The accident examined is the complete severance of a single steam generator tube. The accident is assumed to take place at power with the reactor coolant contaminated with fission products corresponding to continuous operation with a limited amount of defective fuel rods. This event does not include a high energy break into containment. Thus, the proposed modification to remove the automatic CSS actuation logic will not affect the analysis described in this UFSAR section.

The proposed modifications to the RWST will increase the amount of inventory available to mitigate the event. The steam generator tube rupture event is currently mitigated with the available RWST inventory. Therefore, the additional RWST inventory provided by the proposed modifications would represent additional margin. Therefore, the proposed modifications will not affect the results of this UFSAR section.

15. Large break LOCA (Section 15.6.5)

The large break LOCA event is evaluated to ensure compliance with the criterion provided in 10 CFR 50.46. The large break event considered in Section 15.6.5 is defined as a rupture of the RCS pressure boundary with a total cross-sectional area greater than or equal to 1.0 ft^2. The proposed modifications will affect components that function during the large break LOCA analyses.

The proposed changes will not adversely impact the LOCA analysis performed to determine the peak clad temperature. This analysis is a relatively short term analysis that terminates during the cold leg injection phase of a LOCA. The proposed changes to the RWST and CSS actuation will extend the duration of cold leg injection. Therefore, the current calculated peak clad temperatures will not be adversely impacted by the proposed modifications.

The proposed change to CS will not adversely impact the minimum containment pressure analysis included in the peak clad temperature analysis. The absence of CS would be expected to increase the minimum containment pressure as a function of time. For ice condenser plants the change in containment pressure by eliminating CS would be limited.

16. Design basis fuel handling accidents (Section 15.7.4)

There are two events described in UFSAR Section 15.7.4. The first accident is defined as dropping of a spent fuel assembly, resulting in the rupture of the cladding of all the fuel rods in an assembly. The second accident is the postulated drop of one of two weir gates into the spent fuel pool. Both of these events are postulated to occur during refueling operations.

The major analysis inputs are the fission product inventory, spent fuel pool depth, and internal fuel rod pressure. The analysis determines a scrubbing fraction in the spent fuel pool to determine the atmospheric release. The objective of these analyses is to establish that the radiological consequences are within established limits.

The proposed modifications to the RWST and CSS actuation logic do not alter assumptions made in this UFSAR section. CS is not assumed to actuate and the RWST liquid volume is not an input to the analysis. Therefore, the proposed modifications will not affect the results of this UFSAR section.

3.2.11 Impact to Anticipated Transient without Scram (ATWS) Events

The proposed changes will not impact the core response analyses associated with ATWS events. The pressurizer relief valves lift during the course of the ATWS event, eventually causing the rupture disk on the pressurizer relief tank to break. The associated mass and energy release due to the blowdown of the pressurizer relief tank will not produce a limiting containment pressure response.

The proposed modification to remove the CSS actuation logic will be a benefit to the plant response to an ATWS. If the containment pressure were to increase to the high-high containment pressure setpoint, the operation of the ARS fans will be sufficient to ensure an acceptable containment pressure response. By eliminating the possibility of CS Pump operation, the amount of liquid available for core cooling will be maximized and the plant response will be simplified.

3.2.12 Impact to Fire Protection

This proposed amendment has no impact on the plant's ability to respond to fire events. McGuire's fire protection systems and the fire protection plan are not adversely impacted by the proposed changes. In addition, McGuire's licensing basis does not require the simultaneous consideration of a design basis accident coupled with a fire event.

3.2.13 Impact to Lower Inlet Door TS

This proposed amendment has no adverse impact on the functioning of the ice condenser lower inlet doors in response to a design basis accident. The functions of the lower inlet doors are to: 1) seal the ice condenser from air leakage during the lifetime of the unit, and 2) open in the event of a design basis accident to direct the hot steam/air mixture from the event into the ice bed, where the ice absorbs energy and limits containment peak pressure and temperature during the accident transient.

In the event of a design basis accident, the lower inlet doors open due to the pressure rise in lower containment. This allows steam and air to flow into the ice condenser. The resulting pressure increase within the ice condenser causes the intermediate deck doors and the top deck doors to open, which allows the air to flow out of the ice condenser into the containment upper containment. Limiting the pressure and temperature following a design basis accident reduces the release of fission product radioactivity from containment to the environment.

As discussed in the October 2, 2008 McGuire and Catawba license amendment request (Reference 11), opening of the lower inlet doors to small break LOCAs (location and magnitude) is determined by local lower containment pressure. As the developed ice condenser cold head is lost through open lower inlet doors, the remainder of the doors will also tend to open, providing numerous pathways for steam to enter the ice condenser.

The lower inlet doors are designed to open in response to a 1 psf pressure differential. An automatic CSS actuation would occur at a containment pressure of 3 psig. This would correspond to a 432 psf pressure differential across the lower inlet doors, assuming the doors did not open. Therefore, it is expected that absent a CSS actuation, the lower inlet doors will respond as designed in the same manner as they would with the automatic signal in place. As a result, there will be no impact to the lower inlet door surveillance requirements.

3.2.14 Impact to Early Containment Air Return Fan Operation

The analyses that supported the early ARS fan operation submittal considered small breaks that did not reach the CSS actuation setpoint. Therefore, the proposed modification to remove the CSS actuation logic will not impact the analyses that support the associated Safety Evaluation Report.

3.2.15 Impact to Minimum Containment Sump Level Analysis

The proposed modifications will increase the available RWST liquid between the TS minimum and the RWST low level and RWST low-low level alarms. The proposed modifications will also eliminate the automatic CSS actuation logic, eliminating any upper containment holdup penalty prior to reaching sump recirculation. These modifications will result in additional liquid inventory in the containment sump, and thus a higher sump level. Therefore, the proposed modifications will not adversely impact the minimum containment sump level analysis.

3.3 Plant Modifications and Procedure Changes

The following modifications are associated with the proposed TS changes:

- Deletion or disabling the CSS automatic actuation circuitry
- Adjust the RWST low level actuation and alarm setpoint and low-low level alarm setpoint
- Eliminate CSS actuation from the manual Phase "B"/Containment Spray pushbutton
- Installation of a new redundant safety related wide range RWST pre-low level annunciator alarms on the existing level instrument channel
- Replacement of the existing narrow range RWST level transmitters to improve accuracy and support a higher TS minimum limit
- Elimination of CPCS automatic interlocks for CS Pump restart and re-opening of discharge isolation valves

The validation and verification of the design changes proposed by this amendment request were conducted in accordance with directives provided by Duke Energy procedures. These directives describe the process used to create, check and approve engineering changes.

The proposed modifications require changes to emergency, abnormal, and annunciator response procedures and resulting changes to operator actions. These changes are discussed below:

- For certain small break size events, the non safety-related containment ventilation units will be secured and/or isolated to avoid sump dilution and gain sump level margin by melting ice.

- For sequences leading to containment sump recirculation, a verification of adequate sump level will be added just prior to the occurrence of switchover sump level.The RHR pumps will be secured if adequate sump level does not exist.
- Existing steps to secure containment spray when aligned to the RWST will be removed; the RWST will no longer be utilized as a suction source for CS.
- Various steps checking general plant alignment will be adjusted to reflect changes to containment spray status.
- RWST setpoints will be revised to reflect those values stated in Table 3.1.9-1.
- The transfer to cold leg recirculation sequence will be changed as follows:

1. Overview of changes:

   a) Verify successful autoswap of RHR suction (no change).
   b) Start one train of containment spray (in normal sequence).
   c) Allow high head and intermediate head pumps to continue injection from RWST inventory until low-low RWST level.
   d) Align high head and intermediate head pumps to RHR pump discharge.

2. Comparison of sequences:

   <u>Original sequence</u>:

   a) Verify automatic transfer of RHR suction to the containment sump.
   b) Manually transfer high head and intermediate head pump suction to the RHR pump discharge.
   c) Manually transfer containment spray suction to the containment sump (includes aligning heat exchanger cooling water).

   <u>New sequence</u>:

   a) Verify automatic transfer of RHR pump suction to the containment sump.
   b) Manually align and start containment spray from the containment sump.
   c) Scenario dependent time delay while high head and intermediate head pumps reduce RWST level.
   d) Manually transfer high head and intermediate head pump suction to RHR pump discharge.

- Changes to Operator Actions:

1. Manual start of containment spray.

   The manual action to start containment spray occurs in the event sequence roughly at the same time as the "restart" of containment spray in the original sequence. The actions are similar, except only one train of CS is started. The cue to perform this action is a procedure step immediately after aligning the RHR pumps at the RWST low level alarm. This action can be accomplished within the same timeframe as the current action. Adequate time is available, and will continue to be monitored as a time critical operator action.

The time critical operator action to align RHR spray during the transfer to cold leg recirculation sequence will be deleted.

2. Non-safety related cooling to containment will be secured for small break LOCA scenarios when ARS Fans are started as described in Attachment 1, Section 3.1.3. The shutdown or isolation to non-safety related containment ventilation units will be cued by procedure steps associated with the containment air return fans. The actions are control board manipulations requiring approximately two to three (2 to 3) minutes. There is no set limit on the time available. This gains sump level margin for small break LOCAs.

The principle groups involved in the development of this operating strategy were the General Office Safety Analysis group, the Catawba Emergency Operating Procedure group, the McGuire Emergency Operating Procedure group and the McGuire Engineering Primary Systems group. The procedure drafts and any future changes for ECCS Water Management will be validated with actual operators to enhance operator timing and the probability of success, as is the normal practice for Duke Energy emergency operating procedures.

3.4. Changes to Control Room Indications

- The Safety Parameter Display System (SPDS)

  In the original design, CS would normally be in service for any event characterized by containment pressure greater than 3 psig. Following implementation of the proposed modification, CS will not automatically start, and it is not desired to manually start the system until the suction transfer to the containment sump has occurred. An additional decision block is added such that the "ORANGE" path to FR-Z.1 is not enabled until the system has been aligned to the containment sump. A new decision box based on the status of the containment sump alignment will be added. The "ORANGE" path is only allowed if at least one train is aligned to the sump. The criteria in the decision box for determining if CS is "running" will include the pumps running and cooling flow to the containment spray heat exchanger.

  These items are consistent with the Westinghouse Owners Group/Emergency Response Guidelines guidance that the status tree indicates an orange priority if CS is required, but is not operating.

- RWST Level Indication

  1. The safety related setpoint for "FWST 2/3 Lo Level" (the abbreviation "FWST" is the Duke Energy-specific nomenclature for the standard industry abbreviation "RWST") within each of the associated 7300 System protection cabinets will be adjusted to reflect the value in Table 3.1.9-1.
  2. The safety related setpoint associated with the "FWST Lo Lo Level" annunciator will be changed to reflect the Table 3.1.9-1 value.
  3. A new safety related "FWST Pre-Lo Level" annunciator will be added with a setpoint reflecting the value specified in Table 3.1.9-1.

A human factors review of proposed changes to annunciators and status lights on the Control Room Main Control Boards and the Engineered Safety Features Bypass (1.47 Bypass) System is performed.

3.5 Operator Training

The plant modification to the Refueling Water, Containment Spray, and ESFAS Systems and its impact on plant emergency procedure response requires that a training needs analysis be completed. The analysis will determine the scope of impact to the current information in training program areas such as:

- Refueling Water System lesson material
- Engineered Safety Features Actuation System lesson material
- Containment Spray System lesson material
- Emergency procedures lesson materials (as they relate to injection and recirculation core cooling)
- Functional restoration procedures (as they relate to containment conditions during high-energy line breaks inside containment)
- Simulator guides containing the above subject matter

A general discussion of the training options follows.

Classroom training may include:

- An explanation as to the reasons this modification is being installed
- A summary of the engineering modification packages being installed
- Summary descriptions on the type of accident scenarios where the Refueling Water, Containment Spray, and ESFAS System changes will impact operator responses
- A general walkthrough of the affected procedures/explanation of any (to be determined) new or modified operator tasks

Simulator training may include:

- Additional or repeat information from classroom phase of training
- Accident scenarios to exercise the procedure changes, new system operation, and any new or modified skill/task in the form of simulator training guides

The above training will be developed and presented once for all affected licensed operators and non-licensed operators as required. Following completion, the information will be incorporated into the existing training materials and simulator guides similar to any other plant change.

4. REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

General Design Criterion 13 - Instrumentation and Control

"Instrumentation shall be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions as appropriate to assure adequate safety, including those variables and systems that can affect the fission process, the integrity of the reactor core, the reactor coolant pressure boundary, and the containment and its associated systems. Appropriate controls shall be provided to maintain these variables and systems within prescribed operating ranges."

Discussion: The modifications proposed in this amendment request do not compromise the ability to monitor important variables and systems. Deletion of the automatic start function of the CSS will not result in the inability to monitor important reactor core, reactor coolant, or containment parameters. This criterion will continue to be met. The proposed change to adopt TSTF-493, Rev. 4 on a limited basis revises the TS to enhance the controls used to maintain the variables and systems within the prescribed operating ranges, in order to ensure that automatic protection actions occur as necessary to initiate the operation of systems and components important to safety as assumed in the accident analysis.

General Design Criterion 16 - Containment Design

"Reactor containment and associated systems shall be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment and to assure that the containment design conditions important to safety are not exceeded for as long as postulated accident conditions require."

Discussion: The proposed deletion of the automatic start function of the CSS will not compromise the overall effectiveness of the containment in serving as a barrier to fission product release following an accident. The safety analyses performed in support of this amendment request demonstrate that acceptable containment performance will be maintained post-accident. In addition, the containment will continue to be inspected and tested as specified in ASME Code, 10 CFR 50, Appendix J, and TS requirements.

General Design Criterion 19 - Control Room

"A control room shall be provided from which actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain it in a safe condition under accident conditions, including loss-of-coolant accidents. Adequate radiation protection shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 Rem whole body, or its equivalent to any part of the body, for the duration of the accident. Equipment at appropriate locations outside the control room shall be provided (1) with a design capability for prompt hot shutdown of the reactor, including necessary instrumentation and controls to maintain the unit in a safe condition during hot shutdown, and (2) with a potential capability for subsequent cold shutdown of the reactor through the use of suitable procedures.

Applicants for and holders of construction permits and operating licenses under this part who apply on or after January 10, 1997, applicants for design certifications under part 52 of this chapter who apply on or after January 10, 1997, applicants for and holders of combined licenses under part 52 of this chapter who do not reference a standard design certification, or holders of operating licenses using an alternative source term under § 50.67, shall meet the requirements of this criterion, except that with regard to control room access and occupancy, adequate radiation protection shall be provided to ensure that radiation exposures shall not exceed five (5) Rem total effective dose equivalent (TEDE) as defined in § 50.2 for the duration of the accident."

Discussion: The proposed modifications do not in any way result in the loss or degradation of control room or alternate shutdown capability. The dose analyses performed in support of this amendment request demonstrate that control room doses remain within regulatory limits. No design changes are being made to the control room or ancillary shutdown equipment that will be detrimental to the ability to shut down the plant and to maintain shutdown conditions in the event of an accident.

General Design Criterion 20 - Protection System Functions

"The protection system shall be designed (1) to initiate automatically the operation of appropriate systems including the reactivity control systems, to assure that specified acceptable fuel design limits are not exceeded as a result of anticipated operational occurrences and (2) to sense accident conditions and to initiate the operation of systems and components important to safety."

Discussion: This proposed amendment, in part, deletes the automatic start function of the CSS. However, there is no impact on the ability of other protection system functions to be able to automatically start and initiate the operation of systems and components important to safety. Therefore, the ability to meet this criterion is not compromised. The proposed change to adopt TSTF-493, Rev. 4 on a limited basis revises the TS to enhance the controls used to maintain the variables and systems within the prescribed operating ranges, in order to ensure that automatic protection actions occur as necessary to initiate the operation of systems and components important to safety as assumed in the accident analysis.

General Design Criterion 21 - Protection System Reliability and Testability

"The protection system shall be designed for high functional reliability and inservice testability commensurate with the safety functions to be performed. Redundancy and independence designed into the protection system shall be sufficient to assure that (1) no single failure results in loss of the protection function and (2) removal from service of any component or channel does not result in loss of the required minimum redundancy unless the acceptable reliability of operation of the protection system can be otherwise demonstrated. The protection system shall be designed to permit periodic testing of its functioning when the reactor is in operation, including a capability to test channels independently to determine failures and losses of redundancy that may have occurred."

Discussion: The Reactor Trip System and the Engineered Safety Features Actuation System reliability and testability will not be compromised as a result of the requested amendment. Both systems will retain their ability to perform their accident mitigation functions in the event of a single failure of a protection channel. Minimum redundancy requirements will continue to be met during all phases of plant operation, including testing conditions. Testing of these systems will continue to be governed by TS requirements.

General Design Criterion 38 - Containment Heat Removal

"A system to remove heat from the reactor containment shall be provided. The system safety function shall be to reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any loss-of-coolant accident and maintain them at acceptably low levels.

Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure."

Discussion: This criterion will continue to be met with the proposed modifications in place. Even though the automatic start function of the CSS will no longer be required, the system will still be required to be operable by TS as a manually actuated system. The supporting analyses demonstrate that automatic start capability of this system is not required. In addition, the Ice Condenser System will continue to perform its design function in response to accident conditions. No changes are being proposed which will impact the method of operation of the Ice Condenser System. The Ice Condenser System is a passive system which does not rely on the availability of electric power in order to perform its function. Associated systems that are utilized in conjunction with the Ice Condenser System (e.g., the Air Return System) will continue to perform as designed, both with and without offsite electric power available.

General Design Criterion 39 - Inspection of Containment Heat Removal System

"The containment heat removal system shall be designed to permit appropriate periodic inspection of important components, such as the torus, sumps, spray nozzles, and piping to assure the integrity and capability of the system."

Discussion: The proposed amendment will not compromise the ability to meet this criterion. Although the automatic start function of the CSS is being deleted by the proposed modifications, this will not impact the ability to inspect the system. These inspections will continue to be performed as required by TS in accordance with plant procedures.

General Design Criterion 40 - Testing of Containment Heat Removal System

"The containment heat removal system shall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leaktight integrity of its components, (2) the operability and performance of the active components of the system, and (3) the operability of the system as a whole, and under conditions as close to the design as practical the performance of the full operational sequence that brings the system into operation, including operation of applicable portions of the protection system, the transfer between normal and emergency power sources, and the operation of the associated cooling water system."

Discussion: The requested amendment will delete the automatic start function of the CSS. However, the system will still be able to be fully actuated by manual operator action. The mechanical portions of the system will retain their ability to be pressure and functionally tested. Applicable TS requirements will still exist to govern testing of the mechanical portions of the system. The proposed modifications will eliminate CSS actuation from the manual Phase "B"/Containment Spray pushbutton, adjust the RWST low level actuation and alarm setpoint and low-low alarm setpoint, install new redundant safety related wide range pre-low level annuciator alarms, modify existing narrow range RWST level instrumentation to improve accuracy and support a higher TS minimum limit and delete the start of the system via the automatic actuation logic and actuation relays and the containment pressure high-high signal (TS Table 3.3.2-1, Functions 2a, 2b and 2c, respectively). The "full operational sequence that brings the system into operation" consists completely of operator actions taken in accordance with EPs (as revised in accordance with the proposed modifications). No "portions of the protection system" will be applicable to the containment heat removal function. The transfer between the normal (offsite) and emergency (onsite) power sources will continue to be verified as part of TS required AC power source testing requirements. Finally, the operation of cooling water support system capability will continue to be tested.

General Design Criterion 41 - Containment Atmosphere Cleanup

"Systems to control fission products, hydrogen, oxygen, and other substances which may be released into the reactor containment shall be provided as necessary to reduce, consistent with the functioning of other associated systems, the concentration and quality of fission products released to the environment following postulated accidents, and to control the concentration of hydrogen or oxygen and other substances in the containment atmosphere following postulated accidents to assure that containment integrity is maintained.

Each system shall have suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) its safety function can be accomplished, assuming a single failure."

Discussion: The proposed amendment will not compromise the ability of the CSS to perform its role in containment cleanup. The supporting analyses demonstrate that spray removal of diatomic iodine and particulate fission products remains within acceptable limits. No impact on any systems utilized to control the concentration of hydrogen and oxygen in containment is realized in conjunction with the proposed modifications. These systems will retain their ability to perform their design functions in the event of a single failure.

General Design Criterion 42 - Inspection of Containment Atmosphere Cleanup Systems

"The containment atmosphere cleanup systems shall be designed to permit appropriate periodic inspection of important components, such as filter frames, ducts, and piping to assure the integrity and capability of the systems."

Discussion: The CSS will retain its ability to undergo all appropriate inspection requirements following implementation of the proposed amendment. These inspection requirements are conducted in accordance with the McGuire Inservice Inspection Program and TS 3.6.6.

General Design Criterion 43 - Testing of Containment Atmosphere Cleanup Systems

"The containment atmosphere cleanup systems shall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leaktight integrity of its components, (2) the operability and performance of the active components of the systems such as fans, filters, dampers, pumps, and valves and (3) the operability of the systems as a whole and, under conditions as close to design as practical, the performance of the full operational sequence that brings the systems into operation, including operation of applicable portions of the protection system, the transfer between normal and emergency power sources, and the operation of associated systems."

Discussion: The CSS will retain its ability to undergo all appropriate testing requirements following implementation of the proposed amendment. These testing requirements are conducted in accordance with the McGuire Inservice Testing Program and TS 3.6.6.

General Design Criterion 50 - Containment Design Basis

"The reactor containment structure, including access openings, penetrations, and the containment heat removal system shall be designed so that the containment structure and its internal compartments can accommodate, without exceeding the design leakage rate and with sufficient margin, the calculated pressure and temperature conditions resulting from any loss-of-coolant accident. This margin shall reflect consideration of (1) the effects of potential energy sources which have not been included in the determination of the peak conditions, such as energy in steam generators and as required by § 50.44 energy from metal-water and other chemical reactions that may result from degradation but not total failure of emergency core cooling functioning, (2) the limited experience and experimental data available for defining accident phenomena and containment responses, and (3) the conservatism of the calculational model and input parameters."

Discussion: This criterion will continue to be met following implementation of the proposed modifications. The overall function of the containment system will be maintained. Supporting analyses demonstrate that containment performance will remain acceptable following the design basis LOCA. The existing design basis limits regarding post-accident containment pressure and temperature will not be exceeded. In addition, the containment design leakage rate as specified in TS will not be exceeded. The input assumptions inherent in the calculated margin of the overall containment system continue to remain valid.

4.2 Precedent

This license amendment request is similar to that submitted by the Catawba Nuclear Station on September 2, 2008 (ML082490094).

4.3 Significant Hazards Consideration

- The proposed amendment modifies the McGuire TS to: 1) eliminate CSS automatic start on a high-high containment pressure signal, 2) raise the minimum RWST volume limit, and 3) lower the RWST low level actuation setpoint. Plant modifications are required to delete the CSS automatic start function, eliminate CS actuation from the manual Phase "B"/Containment Spray pushbutton, adjust the RWST low level alarm and actuation setpoint and low-low level alarm setpoint, install new redundant safety related wide range pre-low level annuciator alarms, modify existing narrow range RWST level instrumentation to improve accuracy and support a higher TS minimum limit, install redundant wide range RWST pre-low level annunciator alarms, and to lower the RWST low level actuation setpoint.

Duke Energy has evaluated whether or not a significant hazard consideration is involved with the proposed changes by analyzing the three standards set forth in 10 CFR 50.92(c) as discussed below:

Criterion 1:

Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The CSS and RWST are accident mitigation equipment. As such, changes in operation of these systems cannot have an impact on the probability of an accident.

The RWST will continue to comply with all applicable regulatory requirements and design criteria following approval of the proposed changes (e.g., train separation, redundancy, and single failure). The water level on the containment floor will be higher at the start of transfer to the containment sump but will remain below the maximum design level analyzed for equipment submergence. The change in the sump pH will not result in a significant increase in radiological consequences of a LOCA. Therefore, the design functions performed by the equipment are not changed.

The proposed change alters the method of controlling the safety system following a design basis event so that manual actions are substituted for automatic actions. Calculations and simulator exercises confirm these actions will be taken within the appropriate scenario sequence timing to provide containment cooling and source term reduction.

The delay in CS operation will result in an increase in containment temperature, containment pressure, offsite dose, and control room dose during a LOCA or high energy line break inside containment. Containment analyses have been performed to demonstrate that containment pressure and temperature remain within the design limits and there is no significant impact on the environmental qualification for equipment inside containment. The reduction in fission product removal due to delayed CS operation does not result in exceeding the offsite dose and control room dose limits in 10 CFR 50.67. The analysis of the change in containment conditions due to a single failure of an operating spray pump and the suspension of CS determined that the pressure remained below the design limits.

The proposed change to adopt TSTF-493, Rev. 4 on a limited basis clarifies requirements for instrumentation to ensure the instrumentation will actuate as assumed in the safety analysis. Instruments are not an assumed initiator of any accident previously evaluated. As a result, the proposed change will not increase the probability of an accident previously evaluated. The proposed change will ensure that the instruments actuate as assumed to mitigate the accidents previously evaluated. As a result, the proposed change will not increase the consequences of an accident previously evaluated.

Based on this discussion, the proposed amendment does not significantly increase the probability or consequences of an accident previously evaluated.

Criterion 2:

Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

The modification to the low level setpoint will not install any new plant equipment. The setpoint will continue to be included within the engineered safeguards features instrumentation and monitored according to the applicable surveillance requirements. The evaluation of the new level setpoint and the change in the switchover sequence concluded that the equipment aligned to the sump will continue to have sufficient suction pressure prior to containment sump suction switchover. The design of the RWST low level instrumentation complies with all applicable regulatory requirements and design criteria.

The overall function of the CSS is not changed by this proposed amendment. The proposed change alters the method of controlling the safety system following a design basis event so that manual actions are substituted for automatic actions. Calculations confirm that these actions will be taken within the appropriate scenario sequence timing to provide containment cooling and source term reduction with no significant increase in radiological consequences and without exceeding containment design limits.

The proposed change to adopt TSTF-493, Rev. 4 on a limited basis does not involve a physical alteration of the plant (i.e., no new or different type of equipment will be installed) or a change in the methods governing normal plant operation. The change does not alter assumptions made in the safety analysis but ensures that the instruments behave as assumed in the accident analysis. The proposed change is consistent with the safety analysis assumptions.

Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

Criterion 3:

Does the proposed amendment involve a significant reduction in a margin of safety?

Response: No.

The proposed change will increase the calculated radiological dose at the site boundary and in the control room. However, the calculations demonstrate that the dose consequences at the site boundary, low population zone, and control room remain within regulatory acceptance limits of 10 CFR 50.67.

Additional analysis concluded:

- Peak containment pressure for analyzed design basis accidents will not be significantly increased and containment design limits will not be exceeded.
- Assumptions used in the environmental qualification of equipment exposed to the containment atmosphere remain bounding.
- Pumps aligned to the RWST and to the containment sump will have adequate suction pressure.
- The CSS will retain its ability to undergo all appropriate testing requirements following implementation of the proposed amendment. These testing requirements are conducted in accordance with the McGuire Inservice Testing Program and TS 3.6.6.

It is estimated that the implementation of this license amendment request will result in an approximate 22% reduction in core damage frequency. This amendment request is based on the Nuclear Energy Institute (NEI) and the Pressurized Water Reactor (PWR) Owners Group initiative to extend the post-Loss of Coolant Accident (LOCA) injection phase and delay the onset of the containment sump recirculation phase.

The proposed change to adopt TSTF-493, Rev. 4 on a limited basis clarifies the requirements for instrumentation to ensure the instrumentation will actuate as assumed in the accident analysis. No change is made to the accident analysis assumptions and no margin of safety is reduced as part of this change.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, Duke Energy concludes that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of no significant hazards consideration is justified.

4.4 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5. ENVIRONMENTAL CONSIDERATION

Duke Energy has determined that the proposed amendment does change requirements with respect to the installation or use of a facility component located within the restricted area, as defined by 10 CFR 20. It also represents a change to surveillance requirements. Duke Energy has evaluated the proposed changes and has determined that they do not involve: (1) a significant hazards consideration, (2) a significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, or (3) a significant increase in individual or cumulative occupational radiation exposures. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6. REFERENCES

1. Letter from J. F. Stang (NRC) to B. H. Hamilton (Duke Energy), *McGuire Nuclear Station, Units 1 and 2, Issuance of Amendments Regarding Adoption of the Alternate Source Term Radiological Analysis Methodology (TAC Nos. MD8400 and MD8401)*, March 31, 2009 (ML090890627).
2. Letter from J. F. Stang (NRC) to G. R. Peterson (Duke Energy), *McGuire Nuclear Station, Units 1 and 2, Issuance of Amendments Regarding Changes to the Updated Safety Analysis Report and Emergency Operating Procedures [to allow an additional operator action to manually start one containment air return fan in the air return system in response to NRC Bulletin 2003-01] (TAC Nos. MC7461 and MC7462)*, September 25, 2006 (ML062510170).
3. Duke Energy Methodology Report DPC-NE-3004-PA, *Mass and Energy Release and Containment Response Methodology*, Revision 1 (TAC Nos. MA5511, MA5512, MA5517 and MA5518), NRC Safety Evaluation Report dated February 29, 2000 (ML003690464).
4. Letter from J. R. Morris (Duke Energy) to Nuclear Regulatory Commission, *Duke Energy Carolinas, LLC (Duke) Catawba Nuclear Station, Units 1 and 2 Docket Numbers 50-413 and 50-414, Containment Spray System License Amendment Request for Emergency Core Cooling System (ECCS) Water Management Initiative*, September 2, 2008 (ML082490094).
5. Nuclear Regulatory Commission, Regulatory Guide 1.183, *Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors*, Original Issue, July 2000.
6. Letter from B. H. Hamilton (Duke Energy) to Nuclear Regulatory Commission, *License Amendment Request for Full Scope Implementation of the Alternative Source Term*, March 20, 2008 (ML080930505).
7. Letter from B. H. Hamilton (Duke Energy) to J. F. Stang (NRC), *Response to Request for Additional Information Related to the License Amendment Request (LAR) for Implementation of Alternative Source Term (AST)*, March 25, 2009 (ML090860776).
8. Bechtel Corporation, *LOCADOSE NE319, A Computer Code System for Multi-Region Radioactive Transport and Dose Calculation*, Revision 11, December 2006.

9. Letter from S. E. Peters (NRC) to D. M. Jamil (Duke Energy), *Catawba Nuclear Station, Units 1 and 2 Re: Issuance of Amendments [for full scope implementation of alternate source term (AST)] (TAC Nos. MB7014 and MB7015)*, September 30, 2005 (ML052730312).

10. Letter from B. H. Hamilton (Duke Energy) to Nuclear Regulatory Commission, *License Amendment Request for Implementation of Alternative Source Term. Response to Request for Additional Information*, October 6, 2008 (ML082830014).

11. Letter from B. H. Hamilton (Duke Energy) to Nuclear Regulatory Commission, McGuire and Catawba Nuclear Stations, Units 1 and 2, *Amendment Request to Technical Specification 3.6.13, "Ice Condenser Doors," Revised Surveillance Requirements*, October 2, 2008 (ML082900532).

Attachment 2

Marked-Up TS and Bases Pages

TS Markup Inserts

INSERT 1: * The requirements of this function are not applicable following implementation of the modifications associated with ECCS Water Management on the respective Unit.

INSERT 2: * Following implementation of the modifications associated with ECCS Water Management on the respective Unit, the Allowable Value for this Function shall be ≥ 92.3 inches and the Nominal Trip Setpoint for this Function shall be 95 inches

INSERT 3: * Following implementation of the modifications associated with ECCS Water Management on the respective Unit, the RWST borated water volume for this SR shall be ≥ 383,146 gallons

INSERT 4: * Following implementation of the modifications associated with ECCS Water Management on the respective Unit, there will be no automatic valves in the Containment Spray System.

INSERT 5: * Following implementation of the modifications associated with ECCS Water Management on the respective Unit, the requirements of SR 3.6.6.3 and SR 3.6.6.4 shall no longer be applicable.

INSERT TSTF-493 NOTE 1: If the as-found channel setpoint is outside its predefined as-found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

INSERT TSTF-493 NOTE 2: The instrument channel setpoint shall be reset to a value that is within the as-left tolerance around the Nominal Trip Setpoint (NTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative than the NTSP are acceptable provided that the as-found and as-left tolerances apply to the actual setpoint implemented in the Surveillance procedures (field setting) to confirm channel performance. The methodologies used to determine the as-found and the as-left tolerances are specified in the UFSAR.

INSERT 6: ** Following implementation of the modifications associated with ECCS Water Management on the respective Unit, SR 3.6.6.5 is revised to state the following: Verify that each spray pump is de-energized and prevented from starting upon receipt of a terminate signal and is allowed to manually start upon receipt of a start permissive from the Containment Pressure Control System (CPCS).

INSERT 7: *** Following implementation of the modifications associated with ECCS Water Management on the respective Unit, SR 3.6.6.6 is revised to state the following: Verify that each spray pump discharge valve closes or is prevented from opening upon receipt of a terminate signal and is allowed to manually open upon receipt of a start permissive from the Containment Pressure Control System (CPCS).

INSERT 8: After the RHR pumps have been aligned for containment sump recirculation, containment spray pumps are aligned to the sump. Once adequate sump level and containment pressure above 3 PSIG have been confirmed, one spray pump is manually started. The second train of containment spray is available in the event of the failure of the first train.

INSERT 9: For Functions for which TSTF-493, "Clarify Application of Setpoint Methodology for LSSS Functions," has been implemented; this SR is modified by two (2) Notes as identified in Table 3.3.2-1. The first Note requires evaluation of channel performance for the condition where the as-found setting for the channel setpoint is outside its as-found tolerance but conservative with respect to the Allowable Value. Evaluation of channel performance will verify that the channel will continue to behave in accordance with safety analysis assumptions and the channel performance assumptions in the setpoint methodology. The purpose of the assessment is to ensure confidence in the channel performance prior to returning the channel to service. For channels determined to be OPERABLE but degraded, after returning the channel to service the performance of these channels will be evaluated under the plant Corrective Action Program. Entry into the Corrective Action Program will ensure required review and documentation of the condition. The second Note requires that the as-left setting for the channel be returned to within the as-left tolerance of the Nominal Trip Setpoint (NTSP). Where a setpoint more conservative than the NTSP is used in the plant surveillance procedures (field setting), the as-left and as-found tolerances, as applicable, will be applied to the surveillance procedure setpoint. This will ensure that sufficient margin to the Safety Limit and/or Analytical Limit is maintained. If the as-left channel setting cannot be returned to a setting within the as-left tolerance of the NTSP, then the channel shall be declared inoperable. The second Note also requires that the methodologies for calculating the as-left and the as-found tolerances be in the UFSAR.

INSERT 10: For Functions for which TSTF-493, "Clarify Application of Setpoint Methodology for LSSS Functions," has been implemented; this SR is modified by two (2) Notes as identified in Table 3.3.2-1. The first Note requires evaluation of channel performance for the condition where the as-found setting for the channel setpoint is outside its as-found tolerance but conservative with respect to the Allowable Value. Evaluation of channel performance will verify that the channel will continue to behave in accordance with safety analysis assumptions and the channel performance assumptions in the setpoint methodology. The purpose of the assessment is to ensure confidence in the channel performance prior to returning the channel to service. For channels determined to be OPERABLE but degraded, after returning the channel to service the performance of these channels will be evaluated under the plant Corrective Action Program. Entry into the Corrective Action Program will ensure required review and documentation of the condition. The second Note requires that the as-left setting for the channel be returned to within the as-left tolerance of the Nominal Trip Setpoint (NTSP). Where a setpoint more conservative than the NTSP is used in the plant surveillance procedures (field setting), the as-left and as-found tolerances, as applicable, will be applied to the surveillance procedure setpoint. This will ensure that sufficient margin to the Safety Limit and/or Analytical Limit is maintained. If the as-left channel setting cannot be returned to a setting within the as-left tolerance of the NTSP, then the channel shall be declared inoperable. The second Note also requires that the methodologies for calculating the as-left and the as-found tolerances be in the UFSAR.

INSERT 11: The RWST temperature limits were originally established with containment spray aligned to the RWST and were not revised when the Containment Spray System became a manually actuated system with the initial suction source changed to the Containment Sump. The RWST temperature limits are contained within additional analyses and remain valid, although the basis is historical and no longer relevant. The following paragraph is retained for historical purposes only.

INSERT 12: One train of Containment Spray flow is manually initiated with suction on the Containment Sump after commencement of the ECCS sump recirculation mode of operation.

INSERT 13: Containment Spray is manually initiated from the Control Room by opening the Containment Spray System (CSS) Pump discharge valves and starting the CSS Pump. The CSS is typically not activated until an RWST Low-Low level alarm is received. This alarm signals the operator to manually align the ECCS to the recirculation mode and manually initiate containment spray. The CSS maintains an equilibrium temperature between the containment atmosphere and the recirculated sump water. Operation of the CSS in the recirculation mode is controlled by the operator in accordance with emergency operation procedures.

Table 3.3.2-1 (page 1 of 5)
Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL TRIP SETPOINT
1. Safety Injection						
a. Manual Initiation	1,2,3,4	2	B	SR 3.3.2.7	NA	NA
b. Automatic Actuation Logic and Actuation Relays	1,2,3,4	2 trains	C	SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.6	NA	NA
c. Containment Pressure - High	1,2,3	3	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.8 SR 3.3.2.9	≤ 1.2 psig	1.1 psig
d. Pressurizer Pressure - Low Low	1,2,3[(a)]	4	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.8 SR 3.3.2.9	≥ 1835 psig	1845 psig
2. Containment Spray*						
a. Manual Initiation	1,2,3,4	1 per train, 2 trains	B	SR 3.3.2.7	NA	NA
b. Automatic Actuation Logic and Actuation Relays	1,2,3,4	2 trains	C	SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.6	NA	NA
c. Containment Pressure - High High	1,2,3	4	E	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.8 SR 3.3.2.9	≤ 3.0 psig	2.9 psig
3. Containment Isolation						
a. Phase A Isolation						
(1) Manual Initiation	1,2,3,4	2	B	SR 3.3.2.7	NA	NA
(2) Automatic Actuation Logic and Actuation Relays	1,2,3,4	2 trains	C	SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.6	NA	NA

INSERT 1

(continued)

(a) Above the P-11 (Pressurizer Pressure) interlock.

Table 3.3.2-1 (page 5 of 5)
Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL TRIP SETPOINT
6. Auxiliary Feedwater (continued)						
e. Trip of all Main Feedwater Pumps	1,2	1 per MFW pump	K	SR 3.3.2.7 SR 3.3.2.9	NA	NA
f. Auxiliary Feedwater Pump Suction Transfer on Suction Pressure - Low	1,2,3	2 per MDP, 4 per TDP	N,O	SR 3.3.2.7 SR 3.3.2.8 SR 3.3.2.9	≥ 3 psig	3.5 psig
7. Automatic Switchover to Containment Sump						
a. Refueling Water Storage Tank (RWST) Level - Low	1,2,3	3	P,S	SR 3.3.2.1 SR 3.3.2.3 (a)(b) SR 3.3.2.8 (a)(b) SR 3.3.2.9	~~≥ 175.85 inches~~ *	~~180 inches~~ *
Coincident with Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.					
8. ESFAS Interlocks						
a. Reactor Trip, P-4	1,2,3	1 per train, 2 trains	F	SR 3.3.2.7	NA	NA
b. Pressurizer Pressure, P-11	1,2,3	3	Q	SR 3.3.2.5 SR 3.3.2.8	≤ 1965 psig	1955 psig
c. T_{avg} - Low Low, P-12	1,2,3	1 per loop	Q	SR 3.3.2.5 SR 3.3.2.8	≥ 551°F	553°F
9. Containment Pressure Control System	1,2,3,4	4 per train, 2 trains	R	SR 3.3.2.1 SR 3.3.2.3 SR 3.3.2.8	Refer to Note 1 on Page 3.3.2-14	Refer to Note 1 on page 3.3.2-14

INSERT Z

(a) INSERT TSTF-493 NOTE 1
(b) INSERT TSTF-493 NOTE 2

NOTE 1: The Trip Setpoint for the Containment Pressure Control System start permissive/termination (SP/T) shall be ≥ 0.3 psig and ≤ 0.4 psig. The allowable value for the SP/T shall be ≥ 0.25 psig and ≤ 0.45 psig.

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.5.4.1	Verify RWST borated water temperature is ≥ 70°F and ≤ 100°F.	24 hours
SR 3.5.4.2	Verify RWST borated water volume is ≥ 372,100 gallons. *	7 days
SR 3.5.4.3	Verify RWST boron concentration is within the limits specified in the COLR.	7 days

INSERT 3

3.6 CONTAINMENT SYSTEMS

3.6.6 Containment Spray System

LCO 3.6.6 Two containment spray trains shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One containment spray train inoperable.	A.1 Restore containment spray train to OPERABLE status.	72 hours
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3. AND B.2 Be in MODE 5.	6 hours 84 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.6.6.1* Verify each containment spray manual, power operated, and automatic valve in the flow path that is not locked, sealed, or otherwise secured in position is in the correct position.	31 days

(continued)

INSERT 4

SURVEILLANCE		FREQUENCY
SR 3.6.6.2	Verify each containment spray pump's developed head at the flow test point is greater than or equal to the required developed head.	In accordance with the Inservice Testing Program
SR 3.6.6.3*	Verify each automatic containment spray valve in the flow path that is not locked, sealed, or otherwise secured in position, actuates to the correct position on an actual or simulated actuation signal.	18 months
SR 3.6.6.4*	Verify each containment spray pump starts automatically on an actual or simulated actuation signal.	18 months
SR 3.6.6.5**	Verify that each spray pump is de-energized and prevented from starting upon receipt of a terminate signal and is allowed to start upon receipt of a start permissive from the Containment Pressure Control System (CPCS).	18 months
SR 3.6.6.6***	Verify that each spray pump discharge valve closes or is prevented from opening upon receipt of a terminate signal and is allowed to open upon receipt of a start permissive from the Containment Pressure Control System (CPCS).	18 months
SR 3.6.6.7	Verify each spray nozzle is unobstructed.	10 years

* INSERT NOTE 5

** INSERT NOTE 6

*** INSERT NOTE 7

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

- Limit the release of radioactive iodine to the environment in the event of a failure of the containment structure.

INSERT B

~~The containment spray actuation signal starts the containment spray pumps and aligns the discharge of the pumps to the containment spray nozzle headers in the upper levels of containment. Water is initially drawn from the RWST by the containment spray pumps. When the RWST reaches the low low level setpoint, the spray pump suctions are manually shifted to the containment sump if continued containment spray is required. Containment spray is actuated manually or by Containment Pressure-High High.~~

a. ~~Containment Spray-Manual Initiation~~

~~There are two manual containment spray switches, one per train, in the control room. Turning the switch will actuate the associated containment spray train in the same manner as the automatic actuation signal. Two Manual Initiation switches, one per train, are required to be OPERABLE to ensure no single failure disables the Manual Initiation Function. Note that Manual Initiation of containment spray also actuates Phase B containment isolation. Two train actuation requires operation of both Train A and Train B manual containment spray switches.~~

b. ~~Containment Spray-Automatic Actuation Logic and Actuation Relays~~

~~Automatic actuation logic and actuation relays consist of the same features and operate in the same manner as described for ESFAS Function 1.b.~~

~~Manual and automatic initiation of containment spray must be OPERABLE in MODES 1, 2, and 3 when there is a potential for an accident to occur, and sufficient energy in the primary or secondary systems to pose a threat to containment integrity due to overpressure conditions. In MODE 4, adequate time is available to manually actuate required components in the event of a DBA. However, because of the large number of components actuated on a containment spray, actuation is simplified by the use of the manual actuation push buttons. Automatic actuation logic and actuation relays must be OPERABLE in MODE 4 to~~

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

~~support system level manual initiation. In MODES 5 and 6, there is insufficient energy in the primary and secondary systems to result in containment overpressure. In MODES 5 and 6, there is also adequate time for the operators to evaluate unit conditions and respond, to mitigate the consequences of abnormal conditions by manually starting individual components.~~

~~c.~~ ~~Containment Spray-Containment Pressure - High High~~

~~This signal provides protection against a LOCA or an SLB inside containment.~~

~~This is one of the only Functions that requires the bistable output to energize to perform its required action. It is not desirable to have a loss of power actuate containment spray, since the consequences of an inadvertent actuation of containment spray could be serious. Note that this Function also has the inoperable channel placed in bypass rather than trip to decrease the probability of an inadvertent actuation.~~

~~Containment Pressure-High High uses four channels in a two-out-of-four logic configuration. Since containment pressure is not used for control, this arrangement exceeds the minimum redundancy requirements. Additional redundancy is warranted because this Function is energize to trip. Containment Pressure-High High must be OPERABLE in MODES 1, 2, and 3 when there is sufficient energy in the primary and secondary sides to pressurize the containment following a pipe break. In MODES 4, 5, and 6, there is insufficient energy in the primary and secondary sides to pressurize the containment and reach the Containment Pressure-High High setpoints.~~

3. Containment Isolation

Containment Isolation provides isolation of the containment atmosphere, and all process systems that penetrate containment, from the environment. This Function is necessary to prevent or limit the release of radioactivity to the environment in the event of a large break LOCA.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

Phase B containment isolation is actuated by Containment Pressure-High High, or manually, via the automatic actuation logic, as previously discussed. For containment pressure to reach a value high enough to actuate Containment Pressure-High High, a ~~large break~~ LOCA or SLB must have occurred ~~and containment spray must have been actuated~~. RCP operation will no longer be required and CCW to the RCPs and NSWS to the RCP motor coolers is, therefore, no longer necessary. The RCPs can be operated with seal injection flow alone and without CCW flow to the thermal barrier heat exchanger.

PUSHBUTTONS ON THE MAIN CONTROL BOARD.

Manual Phase B Containment Isolation is accomplished by ~~the same switches that actuate Containment Spray. When the two switches in either set are turned simultaneously, Phase B Containment Isolation and Containment Spray will be actuated in both trains.~~

a. Containment Isolation-Phase A Isolation

(1) Phase A Isolation-Manual Initiation

Manual Phase A Containment Isolation is actuated by either of two switches in the control room. Either switch actuates both trains.

(2) Phase A Isolation-Automatic Actuation Logic and Actuation Relays

Automatic Actuation Logic and Actuation Relays consist of the same features and operate in the same manner as described for ESFAS Function 1.b.

Manual and automatic initiation of Phase A Containment Isolation must be OPERABLE in MODES 1, 2, and 3, when there is a potential for an accident to occur. In MODE 4, adequate time is available to manually actuate required components in the event of a DBA, but because of the large number of components actuated on a Phase A Containment Isolation, actuation is simplified by the use of the manual actuation push buttons. Automatic actuation logic and actuation relays must be OPERABLE in MODE 4 to support system level manual initiation. In MODES 5 and 6, there is insufficient energy in the primary or secondary systems to pressurize the containment to require Phase A Containment

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

Isolation. There also is adequate time for the operator to evaluate unit conditions and manually actuate individual isolation valves in response to abnormal or accident conditions.

(3) <u>Phase A Isolation-Safety Injection</u>

Phase A Containment Isolation is also initiated by all Functions that initiate SI. The Phase A Containment Isolation requirements for these Functions are the same as the requirements for their SI function. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead, Function 1, SI, is referenced for all initiating Functions and requirements.

b. <u>Containment Isolation-Phase B Isolation</u>

Phase B Containment Isolation is accomplished by Manual Initiation, Automatic Actuation Logic and Actuation Relays, and by Containment Pressure channels ~~(the same channels that actuate Containment Spray, Function 2)~~. The Containment Pressure trip of Phase B Containment Isolation is energized to trip in order to minimize the potential of spurious trips that may damage the RCPs.

(1) <u>Phase B Isolation-Manual Initiation</u>

(2) <u>Phase B Isolation-Automatic Actuation Logic and Actuation Relays</u>

Manual and automatic initiation of Phase B containment isolation must be OPERABLE in MODES 1, 2, and 3, when there is a potential for an accident to occur. In MODE 4, adequate time is available to manually actuate required components in the event of a DBA. However, because of the large number of components actuated on a Phase B containment isolation, actuation is simplified by the use of the manual actuation push buttons. Automatic actuation logic and actuation relays must be OPERABLE in MODE 4 to support system level manual initiation. In MODES 5 and 6, there is insufficient energy in the primary or secondary systems to pressurize the containment to require

BASES

ACTIONS (continued)

When the number of inoperable channels in a trip function exceed those specified in one or other related Conditions associated with a trip function, then the unit is outside the safety analysis. Therefore, LCO 3.0.3 should be immediately entered if applicable in the current MODE of operation.

A.1

Condition A applies to all ESFAS protection functions.

Condition A addresses the situation where one or more channels or trains for one or more Functions are inoperable at the same time. The Required Action is to refer to Table 3.3.2-1 and to take the Required Actions for the protection functions affected. The Completion Times are those from the referenced Conditions and Required Actions.

B.1, B.2.1 and B.2.2

Condition B applies to manual initiation of:

- SI;
- ~~Containment Spray;~~
- Phase A Isolation; and
- Phase B Isolation.

This action addresses the train orientation of the SSPS for the functions listed above. If a channel or train is inoperable, 48 hours is allowed to return it to an OPERABLE status. Note that for containment spray and Phase B isolation, failure of one or both channels in one train renders the train inoperable. Condition B, therefore, encompasses both situations. The specified Completion Time is reasonable considering that there are two automatic actuation trains and another manual initiation train OPERABLE for each Function, and the low probability of an event occurring during this interval. If the train cannot be restored to OPERABLE status, the unit must be placed in a MODE in which the LCO does not apply. This is done by placing the unit in at least MODE 3 within an additional 6 hours (54 hours total time) and in MODE 5 within an additional 30 hours (84 hours total time). The allowable Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems.

BASES

ACTIONS (continued)

C.1, C.2.1 and C.2.2

Condition C applies to the automatic actuation logic and actuation relays for the following functions:

- SI;
- ~~Containment Spray;~~
- Phase A Isolation; and
- Phase B Isolation.

This action addresses the train orientation of the SSPS and the master and slave relays. If one train is inoperable, 24 hours are allowed to restore the train to OPERABLE status. The 24 hours allowed for restoring the inoperable train to OPERABLE status is justified in Reference 10. The specified Completion Time is reasonable considering that there is another train OPERABLE, and the low probability of an event occurring during this interval. If the train cannot be restored to OPERABLE status, the unit must be placed in a MODE in which the LCO does not apply. This is done by placing the unit in at least MODE 3 within an additional 6 hours (30 hours total time) and in MODE 5 within an additional 30 hours (60 hours total time). The Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems.

The Required Actions are modified by a Note that allows one train to be bypassed for up to 4 hours for surveillance testing, provided the other train is OPERABLE. The Required Actions are not required to be met during this time, unless the train is discovered inoperable during the testing. This allowance is based on the reliability analysis assumption of WCAP-10271-P-A (Ref. 7) that 4 hours is the average time required to perform train surveillance.

If an individual SSPS slave relay or slave relay contact is incapable of actuating, then the equipment operated by the slave relay or slave relay contact is inoperable. An SSPS train is not inoperable due to an individual SSPS slave relay or slave relay contact being incapable of actuating.

D.1, D.2.1, and D.2.2

Condition D applies to:

- Containment Pressure-High;
- Pressurizer Pressure-Low Low;
- Steam Line Pressure-Low;

BASES

ACTIONS (continued)

- Steam Line Pressure-Negative Rate-High;
- SG Water Level – High High (P-14) for the Feedwater Isolation Function.
- SG Water level-Low Low, and
- Loss of offsite power.

If one channel is inoperable, 72 hours are allowed to restore the channel to OPERABLE status or to place it in the tripped condition. Generally this Condition applies to functions that operate on two-out-of-three logic. Therefore, failure of one channel places the Function in a two-out-of-two configuration. One channel must be tripped to place the Function in a one-out-of-two configuration that satisfies redundancy requirements. The 72 hours allowed to restore the channel to OPERABLE status or placed in the tripped condition is justified in Reference 10.

Failure to restore the inoperable channel to OPERABLE status or place it in the tripped condition within 72 hours requires the unit be placed in MODE 3 within the following 6 hours and MODE 4 within the next 6 hours.

The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems. In MODE 4, these Functions are no longer required OPERABLE.

The Required Actions are modified by a Note that allows the inoperable channel to be bypassed for up to 12 hours for surveillance testing of other channels. The note also allows an OPERABLE channel to be placed in bypass without entering the Required Actions for up to 12 hours for testing of the bypassed channel. However, only one channel may be placed in bypass at any one time. The 12 hours allowed for testing, are justified in Reference 10.

<u>E.1, E.2.1, and E.2.2</u>

Condition E applies to:

- ~~Containment Spray Containment Pressure - High High,~~
- Containment Phase B Isolation Containment Pressure - High-High, and
- Steam Line Isolation Containment Pressure - High High.

BASES

ACTIONS (continued)

NEITHER ~~None~~ of these signals has input to a control function. Thus, two-out-of-three logic is necessary to meet acceptable protective requirements. However, a two-out-of-three design would require tripping a failed channel. This is undesirable because a single failure would then cause spurious ~~containment spray~~ ISOLATION initiation. ~~Spurious spray actuation is undesirable because of the cleanup problems presented.~~ Therefore, these channels are designed with two-out-of-four logic so that a failed channel may be bypassed rather than tripped. Note that one channel may be bypassed and still satisfy the single failure criterion.

Furthermore, with one channel bypassed, a single instrumentation channel failure will not spuriously initiate ~~containment spray~~ ISOLATION.

To avoid the inadvertent actuation of ~~containment spray and~~ Phase B containment isolation, the inoperable channel should not be placed in the tripped condition. Instead it is bypassed. Restoring the channel to OPERABLE status, or placing the inoperable channel in the bypass condition within 72 hours, is sufficient to assure that the Function remains OPERABLE and minimizes the time that the Function may be in a partial trip condition (assuming the inoperable channel has failed high). The Completion Time is further justified based on the low probability of an event occurring during this interval. Failure to restore the inoperable channel to OPERABLE status, or place it in the bypassed condition within72 hours, requires the unit be placed in MODE 3 within the following 6 hours and MODE 4 within the next 6 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems. In MODE 4, these Functions are no longer required OPERABLE.

The Required Actions are modified by a Note that allows one additional channel to be bypassed for up to 12 hours for surveillance testing. Placing a second channel in the bypass condition for up to 12 hours for testing purposes is acceptable based on the results of Reference 10.

F.1, F.2.1, and F.2.2

Condition F applies to:

- Manual Initiation of Steam Line Isolation; and
- P-4 Interlock.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.2.3 is the performance of a COT on the RWST level and Containment Pressure Control Start and Terminate Permissives.

A COT is performed on each required channel to ensure the entire channel will perform the intended Function. Setpoints must be found ~~within~~ CONSERVATIVE WITH RESPECT TO the Allowable Values specified in Table 3.3. 2-1. This test is performed every 31 days. The Frequency is adequate, based on operating experience, considering instrument reliability and operating history data.

INSERT 9

SR 3.3.2.4

SR 3.3.2.4 is the performance of a MASTER RELAY TEST. The MASTER RELAY TEST is the energizing of the master relay, verifying contact operation and a low voltage continuity check of the slave relay coil. Upon master relay contact operation, a low voltage is injected to the slave relay coil. This voltage is insufficient to pick up the slave relay, but large enough to demonstrate signal path continuity. This test is performed every 92 days on a STAGGERED TEST BASIS. The time allowed for the testing (4 hours) is justified in Reference 7. The frequency of 92 days is justified in Reference 11.

SR 3.3.2.5

SR 3.3.2.5 is the performance of a COT.

A COT is performed on each required channel to ensure the channel will perform the intended Function. The tested portion of the loop must trip within the Allowable Values specified in Table 3.3. 2-1.

The setpoint shall be left set consistent with the assumptions of the setpoint methodology.

The Frequency of 184 days is justified in Reference 11.

SR 3.3.2.6

SR 3.3.2.6 is the performance of a SLAVE RELAY TEST. The SLAVE RELAY TEST is the energizing of the slave relays. Contact operation is verified in one of two ways. Actuation equipment that may be operated in the design mitigation MODE is either allowed to function, or is placed in a condition where the relay contact operation can be verified without operation of the equipment. Actuation equipment that may not be operated in the design mitigation MODE is prevented from operation by the SLAVE RELAY TEST circuit. For this latter case, contact operation is verified by a continuity check of the circuit containing

BASES

SURVEILLANCE REQUIREMENTS (continued)

the slave relay. This test is performed every 92 days. The Frequency is adequate, based on industry operating experience, considering instrument reliability and operating history data.

SR 3.3.2.7

SR 3.3.2.7 is the performance of a TADOT. This test is a check of the Manual Actuation Functions, AFW pump start, Reactor Trip (P-4) Interlock and Doghouse Water Level - High High feedwater isolation. It is performed every 18 months. Each Manual Actuation Function is tested up to, and including, the master relay coils. In some instances, the test includes actuation of the end device (i.e., pump starts, valve cycles, etc.). The Frequency is adequate, based on industry operating experience and is consistent with the typical refueling cycle. The SR is modified by a Note that excludes verification of setpoints during the TADOT for manual initiation Functions. The manual initiation Functions have no associated setpoints.

SR 3.3.2.8

SR 3.3.2.8 is the performance of a CHANNEL CALIBRATION.

A CHANNEL CALIBRATION is performed every 18 months. The CHANNEL CALIBRATION may be performed at power or during refueling based on bypass testing capability. Channel unavailability evaluations in References 10 and 11 have conservatively assumed that the CHANNEL CALIBRATION is performed at power with the channel in bypass.

CHANNEL CALIBRATION is a complete check of the instrument loop, including the sensor. The test verifies that the channel responds to measured parameter within the necessary range and accuracy.

CHANNEL CALIBRATIONS must be performed consistent with the assumptions of the unit specific setpoint methodology.

The Frequency of 18 months is based on the assumption of an 18 month calibration interval in the determination of the magnitude of equipment drift in the setpoint methodology.

This SR is modified by a Note stating that this test should include verification that the time constants are adjusted to the prescribed values where applicable. The applicable time constants are shown in Table 3.3.2-1.

INSERT 10

SR 3.3.2.9

BASES

LCO (continued)

5, 6. Reactor Vessel Water Level

Reactor Vessel Water Level is provided for verification and long term surveillance of core cooling. It is also used for accident diagnosis and to determine reactor coolant inventory adequacy.

The Reactor Vessel Water Level Monitoring System provides a direct measurement of the collapsed liquid level above the fuel alignment plate. The collapsed level represents the amount of liquid mass that is in the reactor vessel above the core. Measurement of the collapsed water level is selected because it is a direct indication of the water inventory.

Two channels of Reactor Vessel Water Level are provided in both the core region (lower range) and the head region (wide range) with indication in the unit control room. Each channel uses differential pressure transmitters and a microprocessor to calculate true vessel level or relative void content of the primary coolant.

7. Containment Sump Water Level (Wide Range)

Containment Sump Water Level is provided for verification and long term surveillance of RCS integrity.

Containment Sump Water Level is used to determine:

- containment sump level accident diagnosis; and
- when to continue the recirculation procedure.

Two channels of wide range level are required OPERABLE. Each channel consists of wide range level indication and two level switches.

8. Containment Pressure (Wide Range)

Containment Pressure (Wide Range) is provided for verification of RCS and containment OPERABILITY.

OPERATION AND

Containment pressure is used to verify closure of main steam isolation valves (MSIVs), ~~and~~ containment spray Phase B isolation when Containment Pressure - High High is reached.

CONTAINMENT

BASES

LCO (continued)

20. Refueling Water Storage Tank Level

ECCS

RWST level monitoring is provided to ensure an adequate supply of water to the ~~safety injection and spray~~ pumps during the switchover to cold leg recirculation.

Three channels of RWST level are provided. Two channels are required OPERABLE by the LCO.

21. DG Heat Exchanger NSWS Flow

Flow indicators are provided in each of the NSWS trains to indicate cooling water flow through the respective train DG. These indicators are provided for operators to manually control flow to the DG heat exchanger. One flow indicator is required OPERABLE on each train.

22. Containment Spray Heat Exchanger NSWS Flow

Flow indicators are provided in each of the NSWS trains to indicate cooling water flow through the respective train containment spray heat exchangers. These indicators are provided for operators to manually control flow to the heat exchanger. One flow indicator is required OPERABLE on each train.

APPLICABILITY

The PAM instrumentation LCO is applicable in MODES 1, 2, and 3. These variables are related to the diagnosis and pre-planned actions required to mitigate DBAs. The applicable DBAs are assumed to occur in MODES 1, 2, and 3. In MODES 4, 5, and 6, unit conditions are such that the likelihood of an event that would require PAM instrumentation is low; therefore, the PAM instrumentation is not required to be OPERABLE in these MODES.

ACTIONS

A Note has been added in the ACTIONS to clarify the application of Completion Time rules. The Conditions of this Specification may be entered independently for each Function listed on Table 3.3.3-1. When the Required Channels in Table 3.3.3-1 are specified (e.g., on a per steam line, per loop, per SG, etc., basis), then the Condition may be entered separately for each steam line, loop, SG, etc., as appropriate. The Completion Time(s) of the inoperable channel(s) of a Function will be

ACTIONS (continued)

B 3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

B 3.5.4 Refueling Water Storage Tank (RWST)

BASES

BACKGROUND

The RWST supplies borated water to the Chemical and Volume Control System (CVCS) during abnormal operating conditions, to the refueling pool during refueling and makeup operations, and to the ECCS ~~and the Containment Spray System~~ during accident conditions.

The RWST supplies both trains of the ECCS ~~and the Containment Spray System~~ through separate supply headers during the injection phase of a loss of coolant accident (LOCA) recovery. A motor operated isolation valve is provided in each header to isolate the RWST once the system has been transferred to the recirculation mode. The recirculation mode is entered when pump suction is transferred to the containment sump following receipt of the RWST—Low Level signal. Use of a single RWST to supply both trains of the ECCS ~~and Containment Spray System~~ is acceptable since the RWST is a passive component, and since injection phase passive failures are not required to be assumed to occur coincidentally with Design Basis Events.

The switchover from normal operation to the injection phase of ECCS operation requires changing centrifugal charging pump suction from the CVCS volume control tank (VCT) to the RWST through the use of isolation valves.

During normal operation in MODES 1, 2, and 3, the safety injection (SI) and residual heat removal (RHR) pumps are aligned to take suction from the RWST.

The ECCS pumps are provided with recirculation lines that ensure each pump can maintain minimum flow requirements when operating at or near shutoff head conditions.

When the suction for the ECCS ~~and Containment Spray System~~ pumps is transferred to the containment sump, the RWST flow paths must be isolated to prevent a release of the containment sump contents to the RWST, which could result in a release of contaminants to the atmosphere and the eventual loss of suction head for the ECCS pumps.

This LCO ensures that:

a. The RWST contains sufficient borated water to support the ECCS during the injection phase;

BASES

BACKGROUND (continued)

b. Sufficient water volume exists in the containment sump to support continued operation of the ECCS and Containment Spray System pumps at the time of transfer to the recirculation mode of cooling; and

c. The reactor remains subcritical following a LOCA.

Insufficient water in the RWST could result in insufficient cooling capacity when the transfer to the recirculation mode occurs. Improper boron concentrations could result in a reduction of SDM or excessive boric acid precipitation in the core following the LOCA, as well as excessive caustic stress corrosion of mechanical components and systems inside the containment.

APPLICABLE SAFETY ANALYSES

During accident conditions, the RWST provides a source of borated water to the ECCS ~~and Containment Spray System~~ pumps. As such, it provides ~~containment cooling and depressurization,~~ core cooling, and replacement inventory and is a source of negative reactivity for reactor shutdown (Ref. 1). The design basis transients and applicable safety analyses concerning each of these systems are discussed in the Applicable Safety Analyses section of B 3.5.2, "ECCS—Operating"; B 3.5.3, "ECCS—Shutdown". ~~; and B 3.6.6, "Containment Spray Systems."~~ These analyses are used to assess changes to the RWST in order to evaluate their effects in relation to the acceptance limits in the analyses.

The RWST must also meet volume, boron concentration, and temperature requirements for non-LOCA events. The volume is not an explicit assumption in non-LOCA events since the required volume is a small fraction of the available volume. The deliverable volume limit is set by the LOCA and containment analyses. For the RWST, the deliverable volume is different from the total volume contained due to the location of the piping connection. The ECCS water boron concentration is an explicit assumption in the main steam line break (MSLB) analysis to ensure the required shutdown capability. This assumption is important in ensuring the required shutdown capability. Although the maximum temperature is a conservative assumption in the feedwater line break analysis, SI termination occurs very quickly in this analysis and long before significant RCS heatup occurs. The minimum temperature is an assumption in the MSLB actuation analyses.

383,146

For a large break LOCA analysis, the RWST level setpoint equivalent to the minimum water volume limit of ~~372,100~~ gallons and the lower boron concentration limits listed in the COLR are used to compute the post

BASES

APPLICABLE SAFETY ANALYSES (continued)

LOCA sump boron concentration necessary to assure subcriticality, with all rods in (crediting control rod assembly insertion), minus the highest worth rod out (ARI N-1). The large cold leg break LOCA is the limiting case since boron accumulation in the core will be maximized during the cold leg recirculation phase due to core boiling. The accumulation of boron in the core prevents the boron from returning to the sump, which leads to a boron diluted sump condition. A reduction in the RWST minimum boron concentration would produce a subsequent reduction in the available containment sump concentration for post LOCA shutdown, potentially causing the core to become re-critical by injecting boron diluted sump water into the core when switching over to hot leg recirculation.

The RWST minimum boron concentration is also used in the post-LOCA subcriticality verification during the injection phase. For each reload cycle, the all rods out (ARO, no credit for control rod assembly insertion) critical boron concentration is verified to be less than the minimum allowed RWST boron concentration. No credit is taken for control rod assembly insertion when verifying subcriticality during the injection phase, but credit is taken for control rod assembly insertion in the post-LOCA subcriticality calculation during the sump recirculation phase to offset the boron diluted sump condition described above.

The upper limit on boron concentration as listed in the COLR is used to determine the maximum allowable time to switch to hot leg recirculation following a LOCA. The purpose of switching from cold leg to hot leg injection is to avoid boron precipitation in the core following the accident.

INSERT 11

In the ECCS analysis, the containment spray temperature is assumed to be equal to the RWST lower temperature limit of 70°F. If the lower temperature limit ~~is~~ WAS violated, the containment spray COULD further reduce~~s~~ containment pressure, which decreases the saturated steam specific volume. This means that each pound of steam generated during core reflood tends to occupy a larger volume, which decreases the rate at which steam can be vented out the break and increases peak clad temperature. The upper temperature limit of 100°F, plus an allowance for temperature measurement uncertainty, is used in the containment OPERABILITY analysis. Exceeding this temperature will result in higher containment pressures due to reduced containment spray cooling capacity. For the containment response following an MSLB, the lower limit on boron concentration and the upper limit on RWST water temperature are used to maximize the total energy release to containment.

The RWST satisfies Criterion 3 of 10 CFR 50.36 (Ref. 2).

BASES

LCO

The RWST ensures that an adequate supply of borated water is available ~~to cool and depressurize the containment in the event of a Design Basis Accident (DBA),~~ to cool and cover the core in the event of a LOCA, to maintain the reactor subcritical following a DBA, and to ensure adequate level in the containment sump to support ECCS and Containment Spray System pump operation in the recirculation mode.

To be considered OPERABLE, the RWST must meet the water volume, boron concentration, and temperature limits established in the SRs.

APPLICABILITY

In MODES 1, 2, 3, and 4, RWST OPERABILITY requirements are dictated by ECCS ~~and Containment Spray System~~ OPERABILITY requirements. Since both the ECCS ~~and the Containment Spray System~~ must be OPERABLE in MODES 1, 2, 3, and 4, the RWST must also be OPERABLE to support their operation. Core cooling requirements in MODE 5 are addressed by LCO 3.4.7, "RCS Loops—MODE 5, Loops Filled," and LCO 3.4.8, "RCS Loops—MODE 5, Loops Not Filled." MODE 6 core cooling requirements are addressed by LCO 3.9.5, "Residual Heat Removal (RHR) and Coolant Circulation—High Water Level," and LCO 3.9.6, "Residual Heat Removal (RHR) and Coolant Circulation—Low Water Level."

ACTIONS

A.1

With RWST boron concentration or borated water temperature not within limits, they must be returned to within limits within 8 hours. Under these conditions neither the ECCS nor the Containment Spray System can perform its design function. Therefore, prompt action must be taken to restore the tank to OPERABLE condition. The 8 hour limit to restore the RWST temperature or boron concentration to within limits was developed considering the time required to change either the boron concentration or temperature and the fact that the contents of the tank are still available for injection.

B.1

With the RWST inoperable for reasons other than Condition A (e.g., water volume), it must be restored to OPERABLE status within 1 hour.

CANNOT

In this Condition, ~~neither~~ the ECCS ~~nor the Containment Spray System can~~ perform its design function. Therefore, prompt action must be taken to restore the tank to OPERABLE status or to place the plant in a MODE in which the RWST is not required. The short time limit of 1 hour to

BASES

ACTIONS (continued)

restore the RWST to OPERABLE status is based on this condition simultaneously affecting redundant trains.

C.1 and C.2

If the RWST cannot be returned to OPERABLE status within the associated Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.5.4.1

The RWST borated water temperature should be verified every 24 hours to be within the limits assumed in the accident analyses band. This Frequency is sufficient to identify a temperature change that would approach either limit and has been shown to be acceptable through operating experience.

SR 3.5.4.2

PLUS INSTRUMENT UNCERTAINTY

The RWST water volume should be verified every 7 days to be above the required minimum level in order to ensure that a sufficient initial supply is available for injection and to support continued ECCS and Containment Spray System pump operation on recirculation. Since the RWST volume is normally stable and is protected by an alarm, a 7 day Frequency is appropriate and has been shown to be acceptable through operating experience.

SR 3.5.4.3

The boron concentration of the RWST should be verified every 7 days to be within the required limits. This SR ensures that the reactor will remain subcritical following a LOCA and that the boron content assumed for the injection water in the MSLB analysis is available. Further, it assures that the resulting sump pH will be maintained in an acceptable range so that boron precipitation in the core will not occur and the effect of chloride and caustic stress corrosion on mechanical systems and components will be minimized. Since the RWST volume is normally stable, a 7 day sampling Frequency to verify boron concentration is appropriate and has been shown to be acceptable through operating experience.

B 3.6 CONTAINMENT SYSTEMS

B 3.6.6 Containment Spray System

BASES

BACKGROUND

The Containment Spray System provides containment atmosphere cooling to limit post accident pressure and temperature in containment to less than the design values. Reduction of containment pressure and the iodine removal capability of the spray reduce the release of fission product radioactivity from containment to the environment, in the event of a Design Basis Accident (DBA). The Containment Spray System is designed to meet the requirements of 10 CFR 50, Appendix A, GDC 38, "Containment Heat Removal," GDC 39, "Inspection of Containment Heat Removal Systems," GDC 40, "Testing of Containment Heat Removal Systems," GDC 41, "Containment Atmosphere Cleanup," GDC 42, "Inspection of Containment Atmosphere Cleanup Systems," and GDC 43, "Testing of Containment Atmosphere Cleanup Systems" (Ref. 1).

INSERT 12

The Containment Spray System consists of two separate trains of equal capacity, each capable of meeting the system design basis spray coverage. Each train includes a containment spray pump, one containment spray heat exchanger, spray headers, nozzles, valves, and piping. Each train is powered from a separate Engineered Safety Feature (ESF) bus. ~~The refueling water storage tank (RWST) supplies borated water to the Containment Spray System during the injection phase of operation. In the recirculation mode of operation, containment spray pump suction is transferred from the RWST to the containment recirculation sump(s).~~

DESIRED

The diversion of a portion of the recirculation flow from each train of the Residual Heat Removal (RHR) System to additional redundant spray headers completes the Containment Spray System heat removal capability. Each RHR train is capable of supplying spray coverage, if ~~required~~, to supplement the Containment Spray System.

The Containment Spray System ~~and RHR System~~ provide(s) a spray of cold or subcooled borated water into the upper containment volume to limit the containment pressure and temperature during a DBA. ~~The RWST solution temperature is an important factor in determining the heat removal capability of the Containment Spray System during the injection phase.~~ In the recirculation mode of operation, heat is removed from the containment sump water by the Containment Spray System and RHR heat exchangers. Each train of the Containment Spray System~~, supplemented by a train of RHR spray,~~ provides adequate spray coverage to meet the system design requirements for containment heat removal.

BASES

BACKGROUND (continued)

APPROXIMATELY 7.9

For the hypothetical double-ended rupture of a Reactor Coolant System pipe, the pH of the sump solution (and, consequently, the spray solution) is raised to ~~at least 8.0~~ within one hour of the onset of the LOCA. The resultant pH of the sump solution is based on the mixing of the RCS fluids, ECCS injection fluid, and the melted ice which are combined in the sump. The alkaline pH of the containment sump water minimizes the evolution of iodine and the occurrence of chloride and caustic stress corrosion on mechanical systems and components exposed to the fluid.

INSERT 13

~~The Containment Spray System is actuated either automatically by a containment pressure high-high signal or manually. An automatic actuation opens the containment spray pump discharge valves, starts the two containment spray pumps, and begins the injection phase. A manual actuation of the Containment Spray System requires the operator to actuate two separate train related switches on the main control board to begin the same sequence of two train actuation. The injection phase continues until an RWST level Low-Low alarm is received. The Low-Low alarm for the RWST signals the operator to manually align the system to the recirculation mode. The Containment Spray System in the recirculation mode maintains an equilibrium temperature between the containment atmosphere and the recirculated sump water. Operation of the Containment Spray System in the recirculation mode is controlled by the operator in accordance with the emergency operation procedures.~~

DESIRED

The RHR spray operation is initiated manually, when required by the emergency operating procedures, after the Emergency Core Cooling System (ECCS) is operating in the recirculation mode. The RHR sprays are available to supplement the Containment Spray System, if ~~required~~, in limiting containment pressure. This additional spray capacity would typically be used after the ice bed has been depleted and in the event that containment pressure rises above a predetermined limit. The Containment Spray System is an ESF system. It is designed to ensure that the heat removal capability required during the post accident period can be attained.

The operation of the Containment Spray System, together with the ice condenser, is adequate to assure pressure suppression subsequent to the initial blowdown of steam and water from a DBA. During the post blowdown period, the Air Return System (ARS) is automatically started. The ARS returns upper compartment air through the divider barrier to the lower compartment. This serves to equalize pressures in containment and to continue circulating heated air and steam through the ice condenser, where heat is removed by the remaining ice.

BASES

BACKGROUND (continued)

The Containment Spray System limits the temperature and pressure that could be expected following a DBA. Protection of containment integrity limits leakage of fission product radioactivity from containment to the environment.

APPLICABLE SAFETY ANALYSES

The limiting DBAs considered relative to containment OPERABILITY are the loss of coolant accident (LOCA) and the steam line break (SLB). The DBA LOCA and SLB are analyzed using computer codes designed to predict the resultant containment pressure and temperature transients. No two DBAs are assumed to occur simultaneously or consecutively. The postulated DBAs are analyzed, in regard to containment ESF systems, assuming the loss of one ESF bus, which is the worst case single active failure, resulting in one train of the Containment Spray System, the RHR System, and the ARS being rendered inoperable (Ref. 2).

The DBA analyses show that the maximum peak containment pressure results from the LOCA analysis, and is calculated to be less than the containment design pressure. The maximum peak containment atmosphere temperature results from the SLB analysis and was calculated to be within the containment environmental qualification temperature during the DBA SLB. The basis of the containment environmental qualification temperature is to ensure the OPERABILITY of safety related equipment inside containment (Ref. 3).

The ~~modeled~~ THE Containment Spray System actuation ~~from~~ MODELED IN the containment analysis is based on ~~a response~~ time associated with ~~exceeding the containment pressure High-High signal setpoint to~~ REACHING THE RWST LOW LEVEL SETPOINT AND OPERATOR ACTION PRIOR TO achieving full flow through the containment spray nozzles. A delayed response time initiation provides conservative analyses of peak calculated containment temperature and pressure responses. The Containment Spray System total response time ~~of 120 seconds~~ is composed of ~~signal delay, diesel generator startup~~ OPERATOR ACTION, system startup time, and time for the piping to fill.

For certain aspects of transient accident analyses, maximizing the calculated containment pressure is not conservative. In particular, the ECCS cooling effectiveness during the core reflood phase of a LOCA analysis increases with increasing containment backpressure. For these calculations, the containment backpressure is calculated in a manner designed to conservatively minimize, rather than maximize, the calculated transient containment pressures in accordance with 10 CFR 50, Appendix K (Ref. 4).

BASES

APPLICABLE SAFETY ANALYSES (continued)

Inadvertent actuation is precluded by design features consisting of an additional set of containment pressure sensors which prevents operation when the containment pressure is below the containment pressure control system permissive.

The Containment Spray System satisfies Criterion 3 of 10 CFR 50.36 (Ref. 5).

LCO

During a DBA, one train of Containment Spray System is required to provide the heat removal capability assumed in the safety analyses. To ensure that this requirement is met, two containment spray trains must be OPERABLE with power from two safety related, independent power supplies. Therefore, in the event of an accident, at least one train operates.

Each Containment Spray System includes a spray pump, headers, valves, heat exchangers, nozzles, piping, instruments, and controls to ensure an OPERABLE flow path capable of ~~taking suction from the RWST upon an ESF actuation signal and manually transferring suction to the containment sump.~~

BEING MANUALLY INITIATED TO TAKE SUCTION FROM THE CONTAINMENT SUMP AND DELIVERING IT TO THE CONTAINMENT SPRAY RINGS

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause a release of radioactive material to containment and an increase in containment pressure and temperature requiring the operation of the Containment Spray System.

In MODES 5 and 6, the probability and consequences of these events are reduced because of the pressure and temperature limitations of these MODES. Thus, the Containment Spray System is not required to be OPERABLE in MODE 5 or 6.

ACTIONS

A.1

With one containment spray train inoperable, the affected train must be restored to OPERABLE status within 72 hours. The components in this degraded condition are capable of providing 100% of the heat removal after an accident. The 72 hour Completion Time was developed taking into account the redundant heat removal and iodine removal capabilities afforded by the OPERABLE train and the low probability of a DBA occurring during this period.

BASES

ACTIONS (continued)

B.1 and B.2

If the affected containment spray train cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 84 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems. The extended interval to reach MODE 5 allows additional time and is reasonable when considering that the driving force for a release of radioactive material from the Reactor Coolant System is reduced in MODE 3.

SURVEILLANCE REQUIREMENTS

SR 3.6.6.1

Verifying the correct alignment of manual~~,~~ AND power operated, VALVES, ~~and automatic valves~~, excluding check valves, in the Containment Spray System provides assurance that the proper flow path exists for Containment Spray System operation. This SR does not apply to valves that are locked, sealed, or otherwise secured in position since they were verified in the correct position prior to being secured. This SR does not require any testing or valve manipulation. Rather, it involves verification, through a system walkdown or computer status indication, that those valves outside containment and capable of potentially being mispositioned, are in the correct position.

THE SURVEILLANCE INCLUDES VERIFYING THE CORRECT ALIGNMENT OF THE CONTAINMENT SPRAY PUMP DISCHARGE VALVES

SR 3.6.6.2

Verifying that each containment spray pump's developed head at the flow test point is greater than or equal to the required developed head ensures that spray pump performance has not degraded during the cycle. Flow and differential head are normal tests of centrifugal pump performance required by the ASME OM Code (Ref. 6). Since the containment spray pumps cannot be tested with flow through the spray headers, they are tested on bypass flow. This test confirms one point on the pump design curve and is indicative of overall performance. Such inservice inspections confirm component OPERABILITY, trend performance, and detect incipient failures by indicating abnormal performance. The Frequency of this SR is in accordance with the Inservice Testing Program.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.6.6.3 and SR 3.6.6.4

NOT USED

~~These SRs require verification that each automatic containment spray valve actuates to its correct position and each containment spray pump starts upon receipt of an actual or simulated Containment Pressure High-High signal. This Surveillance is not required for valves that are locked, sealed, or otherwise secured in the required position under administrative controls. The 18 month Frequency is based on the need to perform these Surveillances under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillances were performed with the reactor at power. Operating experience has shown these components usually pass the Surveillances when performed at the 18 month Frequency. Therefore, the Frequency was concluded to be acceptable from a reliability standpoint.~~

~~The surveillance of containment sump isolation valves is also required by SR 3.6.6.3. A single surveillance may be used to satisfy both requirements.~~

SR 3.6.6.5 and SR 3.6.6.6

CAN BE MANUALLY OPENED

CAN BE MANUALLY STARTED

These SRs require verification that each containment spray pump discharge valve ~~opens~~ or is prevented from opening and each containment spray pump ~~starts~~ or is de-energized and prevented from starting upon receipt of Containment Pressure Control System start and terminate signals. The CPCS is described in the Bases for LCO 3.3.2, "ESFAS." The 18 month Frequency is based on the need to perform these Surveillances under the conditions that apply during a plant outage.

SR 3.6.6.7

With the containment spray inlet valves closed and the spray header drained of any solution, low pressure air or smoke can be blown through test connections. The spray nozzles can also be periodically tested using a vacuum blower to induce air flow through each nozzle to verify unobstructed flow. This SR ensures that each spray nozzle is unobstructed and that spray coverage of the containment during an accident is not degraded. Because of the passive design of the nozzle, a test at 10 year intervals is considered adequate to detect obstruction of the spray nozzles.

BACKGROUND (continued)

After starting, the fans displace air from the upper compartment to the lower compartment, thereby returning the air that was displaced by the high energy line break blowdown from the lower compartment and equalizing pressures throughout containment. After discharge into the lower compartment, air flows with steam produced by residual heat through the ice condenser doors into the ice condenser compartment where the steam portion of the flow is condensed. The air flow returns to the upper compartment through the top deck doors in the upper portion of the ice condenser compartment. The ARS fans operate continuously after actuation, circulating air through the containment volume. When the containment pressure falls below a predetermined value, the ARS fans are automatically de-energized. Thereafter, the fans are automatically cycled on and off if necessary to control any additional containment pressure transients.

The ARS also functions, after all the ice has melted, to circulate any steam still entering the lower compartment to the upper compartment where the Containment Spray System can cool it.

The ARS is an ESF system. It is designed to ensure that the heat removal capability required during the post accident period can be attained. The operation of the ARS, in conjunction with the ice bed, the Containment Spray System, and the Residual Heat Removal (RHR) System spray, provides the required heat removal capability to limit post accident conditions to less than the containment design values.

In response to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors," McGuire has the option of starting one air return fan at a containment pressure of 1 psig during certain small break LOCA (SBLOCA) transient events. ~~This is an additional manual operator action to prevent or delay reaching the initiation pressure setpoint for containment spray and possible subsequent sump screen debris buildup.~~

APPLICABLE SAFETY ANALYSES

The limiting DBAs considered relative to containment temperature and and pressure are the loss of coolant accident (LOCA) and the steam line break (SLB). The LOCA and SLB are analyzed using computer codes designed to predict the resultant containment pressure and temperature transients. DBAs are assumed not to occur simultaneously or consecutively. The postulated DBAs are analyzed, in regard to ESF systems, assuming the loss of one ESF bus, which is the worst case single active failure and results in one train each of the Containment Spray System, RHR System, and ARS being inoperable (Ref. 1). The DBA analyses show that the maximum peak containment pressure results from the LOCA analysis and is calculated to be less than the containment design pressure.

BASES

APPLICABLE SAFETY ANALYSES (continued)

For certain aspects of transient accident analyses, maximizing the calculated containment pressure is not conservative. In particular, the cooling effectiveness of the Emergency Core Cooling System during the core reflood phase of a LOCA analysis increases with increasing containment backpressure. For these calculations, the containment backpressure is calculated in a manner designed to conservatively minimize, rather than maximize, the calculated transient containment pressures, in accordance with 10 CFR 50, Appendix K (Ref. 2).

The analysis for minimum internal containment pressure (i.e., maximum external differential containment pressure) assumes inadvertent simultaneous actuation of both the ARS and the Containment Spray System.

The modeled ARS actuation from the containment analysis is based upon a response time associated with exceeding the containment pressure High-High signal setpoint to achieving full ARS air flow. A delayed response time initiation provides conservative analyses of peak calculated containment temperature and pressure responses. The ARS total response time of 600 seconds includes signal delays.

~~In the SBLOCA analysis performed in response to NRC Bulletin 2003-01, one ARS fan is manually placed in operation to prevent or delay the start of the Containment Spray System. This will minimize the amount of spray water available to transport debris to the containment sump as well as delay swapover from the Refueling Water Storage Tank.~~

The ARS satisfies Criterion 3 of 10 CFR 50.36 (Ref. 3).

LCO

In the event of a DBA, one train of the ARS is required to provide the minimum air recirculation for heat removal assumed in the safety analyses. To ensure this requirement is met, two trains of the ARS must be OPERABLE. This will ensure that at least one train will operate, assuming the worst case single failure occurs, which is in the ESF power supply.

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause an increase in containment pressure and temperature requiring the operation of the ARS. Therefore, the LCO is applicable in MODES 1, 2, 3, and 4.

In MODES 5 and 6, the probability and consequences of these events are reduced due to the pressure and temperature limitations of these MODES. Therefore, the ARS is not required to be OPERABLE in these MODES.

Attachment 3

NRC Commitments

The following NRC commitments are being made in support of this amendment request:

1. Prior to actually utilizing the provisions afforded by the approved amendments, McGuire will have in place all required design, document, process changes and personnel training necessary to support these provisions on the affected Unit.

2. The requalification and potential modification of Containment Spray System pipe supports will be completed prior to utilizing the provisions of the approved amendment on the affected Unit.

3. Within 180 days of the installation of the associated modifications for the final unit, McGuire will submit a follow-up administrative license amendment request to delete the superseded TS requirements.